THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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ELECTRICITY SUPPLY v. TRAMWAYS.

WHY any rivalry—save in efficiency—or striving for supremacy should arise between municipal committees, respectively engaged in the control of electricity supply and electric tramways, it is difficult to conceive. Technically considered, there is, and can be, no antagonism between the two classes of undertaking; and in the case of the smaller towns, where it is practically essential to combine the two departments under one head, no difficulty is experienced.

It is otherwise, however, in the case of the larger towns, in many of which the two undertakings have hitherto been kept distinct. The magnitude of the operations carried on, and the weight of responsibility upon the shoulders of the management, amply justify the separation of the departments, which, indeed, differ so widely in their nature, that one man can hardly be expected to control them both upon a large scale with efficiency and economy. It would seem that, whether the electricity department supplied the tramways with power, or the latter erected its own generating plant, there ought to be no ground for dissension.

There has, however, of late years been evinced a disposition on the part of the managers of tramways to claim for themselves larger powers, and to encroach upon the field of other municipal officials, especially the borough engineer. This tendency was clearly manifest in Mr. Dalrymple's paper at the Municipal Tramways Convention this year and in the discussion which followed; and recent proceedings at Leeds seem to indicate that the position of the electricity supply engineer may also be endangered.

As our readers are well aware, the electricity supply department of the Leeds Corporation is under the control of Mr. Harold Dickinson, a central station engineer who stands in the front rank of his profession, and holds an unblemished record for skill and ability, both technical and commercial. The tramways are controlled by Mr. J. B. Hamilton, who possesses a reputation as a tramway manager fully equal to that of Mr. Dickinson as an engineer. Each department has its own electrical plant, and there is no ostensible reason why peace should not reign between them.

There has been, however, in Leeds a question of some years' standing, as to whether the tramways in the outlying districts should be supplied from the existing high-pressure system of the electricity department or from new plant to be put down by the Tramways Committee. After considerable friction between the two Committees, the latter alternative was adopted, whether rightly or wrongly does not concern us here. There the matter might well have rested: but recently a proposal has been put forward, and is being vigorously pressed by a section of the Council, for the amalgamation of the Committees, somewhat after the fashion of the peaceful alliance of the lion and the lamb—the chairman and the deputy-chairman of the Tramways Committee occupying the same offices in the new Committee. We do not object to this, but the probability is that it will be

followed by an attempt to make the electrical engineer subordinate to the tramways manager—a position which can only be characterised as ridiculous, and which would be extremely distasteful to both parties (for we do not for a moment believe that Mr. Hamilton desires to supplant his colleague).

We sincerely trust that this insidious and misguided attack upon the supremacy of the electrical engineer in his own department—the control of which, of all departments of municipal activity, requires the most highly technical and specialised knowledge—may be defeated. A more appropriate course would be to place the whole of the electrical plant and mains under the sole control of the electrical engineer, who should be responsible for the maintenance of a supply of electrical energy to the tramways, the latter paying for it at an agreed price. If the cars were propelled by town gas, would any sane man suggest that the gas supply department should be placed under the control of the tramways manager? The idea is absurd, on the face of it.

As a striking contrast to the proceedings at Leeds, we may refer to the recent decision of the Corporation of Halifax, where, after seven years' experience, it has been resolved to place both tramways and electricity supply under the control of Mr. Rogerson, the electrical engineer, who will, of course, be assisted by expert Traffic and Rolling Stock Superintendents. While we do not advocate this course, except for small undertakings, it possesses advantages—and it is certainly vastly preferable to the anomalous arrangement proposed at Leeds.

Copper. The drawbacks to the consumer of having the bulk of the production under speculative control have been often illustrated before this year. It would be comforting to think with the writer of a recent article in the *Financial News*, that the prospects of Australian production are such as to warrant the anticipation that that country is destined to become one of the greatest of the world's producers in the future. The last output given, 36,300 tons for 1906 (this year probably increased to about 40,000), bears no comparison with that of the States. It would seem, also, that the leading producers are at present in a position to supply the world's demand, if they so wish, and can therefore drop the price, and so make it unremunerative for other, and more distant, mines to compete when it is desired to limit the output. The suspension of work in the Copper Queen Mine, recently reported, shows how quickly the output is made to respond to a fall in price.

It is to be desired that Australia, as an enterprising colony, should advance to a position from which she could assist in balancing the market by the contribution of a solid output, but the indications so far are in favour of richer country than has hitherto been worked there.

The *Financial News* article quotes figures from a few leading mines, and incidentally mentions three new ones in the Cloncurry district, registered last year. If these latter can operate at a profit under the existing depressed conditions, Australia should have no difficulty in disposing of all the copper she can produce, a low cost of production permitting of a low price, but cannot influence the market to any great extent with the present comparatively small output.

The *Financial Times*, in a note on Messrs. J. Lewis and Son's report, comments on the increased buying, both here and in the States, during November, total deliveries in Europe for the fortnight ending 21st being 21,800, against an average of 13,700, and estimated purchases in the States for the same period 20,000 tons. It is probably this activity which has kept the price fairly steady, with occasional tendencies towards a rise. The visible supplies are high, Messrs. Merton's report showing stocks 15,789 tons for November 30th, as against 12,728 tons for October 31st. This increase is almost entirely due to North America, shipments from Australia showing lower than usual.

Sutton in Darkness. Happily it is not often at the present day that one is called upon to reiterate complaints on the score of low pressure and failure of supply in connection with modern electricity undertakings.

Indeed, there are few concerns which cannot justly pride themselves on the result of their efforts to cure these, almost inexcusable, faults—but still there are a few, and among them we should imagine that the supply authority of Sutton (Surrey) deserves a very prominent position.

Not once, during the past few weeks, but many times have the unfortunate consumers in this area been plunged into unwonted obscurity, through the failure of the electric lighting, to their natural disgust and to the great detriment of the supply authority—if it would but see it. That these failures—which affected both public and private lighting—do not appear to have been accompanied by any authorised explanation, is the more remarkable in view of the strenuous competition in illuminating matters which exists to-day; they certainly demand energetic measures, not only of prevention, but also of pacification, judging from local reports.

Bearing in mind that these defects are usually traceable to neglect in some form or other, that they absolutely discredit electric lighting, and will certainly lead to reprisals on the part of consumers, we cannot believe that those interested will quietly acquiesce in the commercial suicide of their concern—for that is what it means. We regret that it should be in any way necessary to revert to such matters at the present day, but such a glaring example of inefficiency is a danger to the supply industry as a whole, and calls for drastic treatment on that account alone.

The Tramcar Brake Question.—The following members of the Municipal Tramways Association Brakes Sub-Committee visited Burton-upon-Trent last Friday evening, and left on Saturday morning, the visit being made specially for the purpose of inspecting the new brake designed by Mr. P. J. Pringle. The members carefully examined the details of the brake, and saw a number of tests, in which they evinced considerable interest. The Committee was represented by the following members:—Messrs. J. Aldworth, Nottingham; A. R. Fearnley, Sheffield; J. M. McElroy, Manchester; H. Mozley, Burnley; C. J. Spencer, Bradford.

The main features claimed for this brake are that it is entirely mechanical, its maximum power is instantaneous in application, it requires no power for applying, and calls for the most elementary motion, the conductor having the same control over it as the motorman. The above features are stated almost entirely to eliminate the failure of the personal element, which is always a very grave question.

Engineering Scholarships.—With a view of attracting to its service young men of the highest intelligence, the Daimler Engineering Co. (1904), Ltd., is offering five scholarships, to be awarded in July, 1908, and to be tenable at the Daimler Works, Coventry, for two years. One of these is worth £100 per annum, and the others £20 each; all carry instruction in the theory of motor engineering for two years, together with a systematic course of shop instruction, and are subject to a proviso that the holder shall agree to serve the company at a salary of not less than £150 a year for two years after the expiration of the scholarship. The scholarships will be awarded on the results of an examination, of which particulars can be obtained from the company, by addressing the Pupils' Department.

ELECTRIC TRAMWAY ACCOUNTING AND FINANCE.

By ELECTRIC.

(*Concluded from page* 788.)

Stores.—One of the important factors in the successful management of an electric tramway undertaking is the purchase of stores and materials on economical conditions and terms. Some companies purchase their stores, for the greater part, as the necessity arises, that is, they do not contract to any great extent (except for coal in the case of companies generating their own current) in the ordinary course of business. Others enter into periodical contracts or arrangements for much of their requirements, the usual routine embodying the preparation in printed form of a schedule of stores containing a certain amount of descriptive detail, with probable requirements, and requesting prices delivered at the company's stores. Each proceeding has its advantages and disadvantages, and a judicious blend of the two may be conducive to the best result. The ordinary routine in dealing with the reception and issue of stores may be briefly noticed. The advices of despatch are handed to the Stores Clerk, who sees that the goods received are in accordance therewith, the Manager being responsible for the quality. The invoices relating thereto are also handed to the Stores Clerk, by whom, as well as by the Manager, they are initialled after having been passed. The goods are entered in the Stores Book in accordance with the invoices as passed, and the latter, properly allocated, are given to the book-keeping department for inclusion in the head office records and for payment. Issues of stores are made upon the production of allocated orders or requisitions, which are signed by authorised persons, and also by the receiver of the stores upon execution. These requisitions are then priced, valued accordingly, arranged in order of date and posted to the different accounts in the Stores Ledger, which is arranged according to description, each account showing on the one side the goods received and taken into stock, and on the other the issues therefrom, the difference, of course, representing the stock on hand. There are other methods of recording the receipt and issue of stores; but in practice the method cursorily noticed seems to find most favour.

Depreciation.—The subject of electric tramway depreciation has been so frequently treated as to render it almost threadbare. No undertaking can be regarded as financially sound without adequate provision for wear and tear, which is only another phrase for depreciation. Sometimes, however, the provision made for depreciation is, unfortunately, a casual and negligible quantity, and though we may talk profoundly about the estimated lives of rails, cars, cables and other depreciating component parts of electric tramway equipment, and may be sinking funds, annuity systems, diminishing balances, and other methods of computation, the fact remains that the ordinary dividend determines the allowance, if any, to be deducted for wear and tear. The amount included for depreciation in the frequently so-called "appropriation," or "net profit appropriation," is such as the circumstance of the payment of an ordinary dividend and the seemliness of the carry forward will admit.

Depreciation, though a loss, and therefore a charge against revenue, is usually subservient to the payment of dividends, and the degree of subserviency may be accentuated by controlling trammels. There is consequently little or no method (where it is provided) in the manner of its provision. Most "appropriations" are of the paper variety, and their value in stress must be regarded accordingly. The reservations for depreciation or renewals are usually indicated on the liabilities side of the balance-sheet. There is no uniform mode of expressing such allowances; but where they exist on paper exception may be taken to the incorporation in any title of the term "fund," which in such circumstances is non-existent.

In many cases if, and when, the purchasing authority exercises its powers, questions of account arise in which it is important that there should be employed by it the services of an accountant who is, of course, experienced in tramway accounts, and who is also familiar with the general administration and practice of electric tramway companies.

Board Meeting.—The periodical board meeting in the ordinary course is a very simple affair in the procedure of electric tramway company administration. An occasional glimpse of light and shade with probably a breezy atmosphere at rarer intervals relieve the monotonous tenour of some of these functions. Here you may find various types. The opening voluntary of the meeting takes the form of the reading of the minutes of the preceding meeting by the secretary, and confirming them if correct. The secretary may be required to read them in a standing attitude, or he may be required to read them seated—equalité—according to the prevailing degree and element of self-credited majesty and autocracy assembled. Traffics may occupy a little time, of which there will be submitted a statement in the usual form. Finance may come next. A statement showing the current financial position of the company with the submission of cheques for signature, and confirmation of those which have been issued since the previous meeting, followed by the general items appearing on the agenda for discussion, confirmation or sanction, and terminating in the transfers usually to be formally passed, and the authorisation and signature of new certificates. And so we proceed. Now and again we may witness or be participators in an ill-grounded fault-finding spectacle—just to show that the fault-finder is in fleeting evidence. He is usually imbued with a keen sense of impressing what little knowledge he possesses, and his importance, upon the attention of others, frequently with the reward of temporary apparent success.

Balance-Sheet and Profit and Loss Account.—In order of statement the fixed assets precede the floating assets. The first item on the credit side is usually connoted by capital expenditure, and being of a heterogeneous character it may comprise any or all of the following considerations:—Expenditure upon new lines, embracing permanent way construction, general electrical equipment, cars, and land and buildings, purchase of horse lines and their electrification, goodwill, parliamentary powers and so forth. Details of the capital expenditure, particularly in regard to the nature of the charges incorporated therein, should be available in schedule form for the auditor, and carefully scrutinised by him. The capital accounts of many electric tramway companies are pretty well watered, and the natural tendency, of course, is to capitalise.

Preliminary expenses may be found specifically but baldly stated, and their composition is often permeated with considerable mystery. The usual definition is that it represents expenses incurred in connection with the promotion and formation of the company; but in practice this definition has been rendered susceptible to a wider interpretation. Whether the item be exhibited *per se*, or whether it be buried in a group of expenditure, its tenure as an asset, or rather as an item of capital expenditure in the balance-sheet, should be of brief duration. Careful investigation of its composition on the part of the auditor is necessary, involving, as it often does, the examination of agreements, minutes, allotments of shares, and/or debentures and other financial paraphernalia.

Sundry Debtors and Debt Balances.—The major portion of this item will be found generally to consist of debit balances. The debtors proper may comprise those on account of advertising, sales of old material, and other dissimilar debits, whilst the debit balances may be located in proportions of rates, insurances, and other standing charges paid in advance. Altogether the group, of which there should be a detailed schedule, is easy to check.

Stock of Stores and Materials, probably including, *inter alia*, ticket and clothing stock issue, should be supported by a detailed schedule certified by the manager. Inquiry thereon may be directed towards ascertaining whether it contains any antiquated items that are not likely to be used by the company, any scrap material, how its value has been arrived at, and what accounts have been credited with it, and many other queries.

Deposits against obligations may be simply stated, whilst should there happen to be any investments they will be probably be stated at cost, in which event in the case of registered stocks the certificates will be available unless any have been given with a blank transfer as security for the

repayment of loans or advances, &c., whilst in the case of inscribed stock there will be produced the certificate of the bank or house at which the stock is inscribed. The office furniture and fittings may be separately exhibited, and the cash at bankers and on hand will be reconciled with the bank pass book and the cash records.

On the liabilities side of the balance-sheet, we may pass from the statement of the share and debenture capital and forfeited shares, if any, to sundry creditors and credit balances. The former often comprises both trade and cash creditors. In a well-regulated undertaking, and where there is a sufficiency of working capital, the trade creditors in the ordinary way should be represented principally by the unpaid accounts for the last month of the financial year. Any comparatively small charges accrued and unpaid will figure amongst the credit balances. Any large and important sums should be specifically stated. Debenture interest accrued should be separately shown, as well as any loans or advances with the interest accrued and unpaid to date, reference being made in the narration to any security given for repayment. If the company has issued any of its debentures against such loans or advances they should be shown as in reduction of the liability.

Assumption of liabilities of vendors and others for considerations received should be singly indicated.

Unclaimed Dividends and Interest.—It is the usual practice to create a dividend and debenture interest account at the bank by transferring thereto from the current account the sums required to pay dividend and debenture interest warrants. This is done by debiting dividend or interest account as the case may be, the former being transferred to the appropriation section of the profit and loss account, and the latter to the profit and loss account. In this way any unclaimed dividends or interests do not appear in the balance-sheet. Another practice whereby such unclaimed sums are indicated in the balance-sheet, may be illustrated as below :—

Say, dividend, 100,000 shares at 5 per cent. = £5,000, less tax = £4,750. Amount claimed at end of financial year, say, £4,700. We, therefore, have—

Cash.

		Dividend account A.B. Bank	£4,750

A.B. Bank Dividend Account.

Cash	£4,750	Sundry persons for dividend warrants paid during the year	£4,700

Sundry Persons for Dividends.

Income-tax	£250	P. & L. account ...	£5,000
A.B. Bank dividend account	4,700		

Profit and Loss (App. Sec.)

Sundry persons for dividend	£5,000		

Income-Tax.

		Sundry persons ...	£250

Here it will be noticed is a debit balance on the A.B. Bank Dividend Account held for the payment of the credit balance of £50 to sundry persons for dividends.

We may have next a debenture sinking fund, consisting of appropriations of the credit balance of profit and loss account, which sometimes correspond with those required for redemption. The result is that when the debenture obligation has been extinguished there remains as a liability the total of the periodical sums which have been so accumulated, and the debenture sinking fund becomes, *ipso facto*, a reserve. The following *pro-forma* accounts illustrate the point :—

Before liquidation of the debentures.

X.Y.Z. Electric Tramway Co., Ltd.

Share capital... ...	£100,000	Assets	£162,500
Debenture capital ...	25,000		
Sundry creditors and credit balances ...	2,500		
Debenture sinking fund	25,000		
Revenue account ...	10,000		
	£162,500		£162,500

After.

Share capital	£100,000	Assets	137,500
Sundry creditors and credit balances ...	2,500		
Reserve	25,000		
Profit and loss ...	10,000		
	£137,500		£137,500

Much controversy has raged over the sinking fund question in relation to the accounts of municipal authorities. It is a very wide subject, but, incidentally, it may be stated that the sinking fund, as far as it goes, is a contribution towards depreciation.

Then we may have a depreciation or a renewal account, followed by a reserve fund, which is always an interesting discovery. A reserve fund is generally defined as the excess of assets over liabilities, including paid up capital. The investment or otherwise, and the cost of reserves, form very debateable subjects, and will be fully treated in a separate article upon the finance of electric tramway companies. The concluding item is the credit balance (should there be one) of the profit and loss account, less any interim dividends paid.

On the credit side of the revenue account, the income may comprise, in addition to the traffic receipts, interest on loans, dividends and interest on investments received and receivable, transfer and other fees, commissions and profits in the shape of shares and debentures and sundry receipts, whilst on the debit side we have such classifications of expenditure as running expenses, repairs and maintenance, purchase of or generation and distribution of current, rents, rates and insurances, interest on loans, paid and payable, debenture interest, general administration expenses, less any amount capitalised.

CORRESPONDENCE.

***Letters received by us after 5 p.m. on Tuesday** cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Wireless Telegraphy.

With reference to Mr. Harold A. Hall's letter in your issue of November 29th last regarding a wireless telegraph apparatus, my recent invention, No. 19,077 of 1907, embodies the principle suggested.

I employ a revolving conductor which is in electrical contact with one or more closed or endless conductors. When in motion the revolving conductor must, at some position of its movement, encircle the greatest number of electric oscillations (or lines of force).

When the apparatus is required to be made small, for use on ships, &c., to make the closed conductors more sensitive they are given a number of turns.

Regd. R. Osman.

London, *December 5th*, 1907.

Prepayment Meters.

The chief uses of prepayment meters are to facilitate the collection of accounts and at the same time to restrict the amount of credit given to consumers, it being difficult to apply the methods commonly resorted to in other businesses to attain these ends, due to not having the same control over accounts and discounts. For example, one cannot pick or choose customers to the same extent, and the originating order really never terminates. Prepayment meters are the only means of making troublesome accounts good business and placing them well under control.

The well-to-do consumer gets his account, pays by cheque, and seldom has occasion to think about his meter ; in the case of the prepayment one, the consumer is brought day by day into contact with it, and money is demanded on the spot, so no sympathy exists between them. This obviously renders the design and sealing of the case a matter of more importance than in the ordinary meter ; and in this respect the existing prepayment meters are open to adverse criticism.

The function of the ordinary meter is to record the amount consumed, from which the value of the same is calculated and the account collected. That of the prepayment meter is primarily to collect the account, there being no difficulty in calculating from it the amount consumed. Hence the purpose served by recording the number of units passed through the prepayment meter is: (1) To check the honesty of the man who collects the money. (2) To ascertain whether money had been previously removed from the meter, or, in other words, to check the honesty of the consumer. The fact that the "undertaker must bear the loss" (ELECTRICAL REVIEW "Legal Column," May 24th, 1907) of any such deficiency, renders the proper sealing of the meters the right way of disposing of this difficulty. (3) In case the automatic switch failed to break the circuit at the proper time, the recording dials would show the deficiency; but the switch being comparatively simple and safe, it would pay to take the risk and dispense with the dials. In the case of the meter going too fast or too slow, or stopping, with the switch in, there would be a corresponding error in the money deposited in the meter and the recording dials.

Hence, to dispense with the current-consumption indicator, the signal before switching off, and the indicator showing how much is paid for and when coin is required, would simplify the whole mechanism; then the simpler it is, the more reliable and cheaper the meter can be made—just what is wanted.

In Dublin there are said to be 22,000 prepayment gas-meters.

Call Again.

Standard Wall Plugs.

Would it not be possible for manufacturers to make an arrangement to manufacture a standard wall plug? At the present time there is endless trouble with these. It is frequently impossible to get a plug to fit an existing base, and manufacturers appear to delight in making small variations, which make the parts non-interchangeable. Why should wall plugs not be standard in the same way that lamp-holders are?

C. Turnbull.

Electricity Works, Tynemouth,
December 5th, 1907.

[A sub-committee of the Engineering Standards Committee was appointed a long time ago to deal with accessories of this kind, but has not yet reported.—EDS. E.R.]

Localising Faults.

With reference to the letter by "A Fault Finder" in your issue of November 22nd, dealing with the method of fault finding described in my article on continuous-current three-wire distribution, which appeared in your issue of October 25th, I made no claim for originating this method of fault localising. I noticed a brief reference to it some time ago, and the idea seemed of no practical use. An experiment on an actual fault already roughly located by the drop of potential method gave such surprising results, that after further experience with the method I was convinced that for many classes of faults it was much superior to the ordinary methods dealt with in the text-books on the subject. Its great accuracy, the simple apparatus required, and the fact that not even the faulty cable was required to be disconnected from the line mains, showed that it deserved making as widely known as possible.

My experience with this method has been confined to cables laid solid, and cables drawn into earthenware and iron ducts. As to lead-covered or armoured cables, I am of the opinion that any serious fault would burn the metallic covering completely through, thus breaking the continuity of the covering and allowing the current to pass directly to earth, and permitting the fault to be exactly located.

The case mentioned in the article of a faulty cable drawn through an iron pipe between two street-boxes, seems to resemble the case of a lead-covered or armoured cable.

With regard to lead-covered mains drawn into earthenware conduits, a fault occurring in this case would be located down to one particular length of cable in the ordinary way, and then lifting the street box covers should enable the fault to be found. The smoke resulting from the fault would travel in either direction along the duct to the two nearest street boxes.

There is a happy mean between the pick and shovel, cut and try mains engineer, and the highly scientific man with his cartload of delicate testing sets. The experiences of practical men with the results of actual cases are what are most required in the solving of the quickest method of removing faults from cable systems.

W. A. Toppin.

Greenock, *December 2nd*, 1907.

Prepayment Supply.

I have been interested in an article in your issue of this week by "Central Station Man" about prepayment supply.

I am very much surprised at the attitude "Central Station Man" takes, more especially when we see what a good thing the gas people are making out of prepayment meters. I am not in sympathy with "Central Station Man" when he states that a supply should not be given at a price less than 7d. per unit. But this high price seems to be brought about by free wiring. I cannot see how a station can afford to wire a house at an average cost of £7 10s. (this does not include the cost of service and meter), when, from details stated, the revenue from the same is only £1 8s. per annum. Prepayment meters, I am certain, would pay well under certain conditions. If possible, the landlord should be induced to wire the cottages when they are being built. I do not think many landlords would pay outright for this, but they might pay a rental on an assisted wiring scheme, as I consider the class of cottage suitable for a prepayment meter should not cost more than £3 or £4 to wire. The lamp renewals must be put in free, I think, if the consumers are to be kept.

W. A. Walker,
Resident Engineer.

Kettering Electricity Works,
December 7th, 1907.

Your contributor in last week's issue evidently believes in keeping a tight hand on the small consumer, as a consequence of which the system adopted fails to become popular, and, in spite of the high charge per unit, can never show an adequate return. If a little more generous treatment of this class of consumer fails to improve matters, then, indeed, it must still be that the electric light is for the classes only. There is the richest vein in the strata still practically untapped—the thrifty working classes living in houses at from £12 to £20 rental, to whom a system of prepayment through the meter, on the lines of the penny-in-the-slot gas-meter, appeals strongly. This class, approached in a generous and effective manner, would put new life into many electric supply undertakings, as was the case with the gas concerns.

H. N.

Enterprise on the Part of British Firms.

In your issue of August 9th, Messrs. Lyell & Co. deplore "lack of enterprise." My experience is the reverse of theirs. In answer to my request for lists, I have received 40 replies, including the most prominent electrical and mechanical engineering firms, and probably I shall have a few more by next week's mail. I beg to take this opportunity of thanking the various firms and gentlemen who have had the enterprise and courtesy to reply.

S. Irwin-Crookes.

Auckland, New Zealand,
October 28th, 1907.

Premium Apprenticeship.

I observe in your issue of November 29th an article by Mr. C. A. Smith, B.Sc. I am sorry to say that my experience in one branch of the engineering profession, namely, municipal electrical engineering, differs very much from his, in that to my mind the "premium pupil" has not gone. I would that it were so.

I am personally acquainted with a case in which a Univer-

sity man (a B.Sc.) was employed by a Corporation for a period of about four years, during which time his salary had risen to the munificent sum of £4 4s. per month. And worse still, his prospects of advancement at that place were *nil*, simply due to premiums' having to be "pushed on," whether competent or not. On more than one occasion, as a last resource, the advice of this man was asked, and acted upon by his superiors in position, who were receiving a salary many times greater than his.

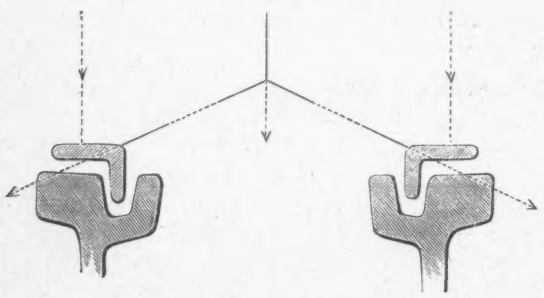
Neither can it be argued that he lacked push or ability, for after being driven from municipal work in disgust, he has now become an engineering demonstrator in one of our best technical colleges, and one from which many of our eminent engineers have received their training. Of course, had this unfortunate individual been employed by a company, he would probably have fared better, as profits would count before influence due to premiums.

Justice.

Brakes for Tramcars.

Kindly allow me through the medium of your "Correspondence" column to suggest an improved application of the slipper brake on tramcars.

I suppose that the progress of a runaway car is opposed by friction alone on the present type of brake. Why not give this slipper a lip to come into contact with the inside



of each rail and apply the controlling power diagonally to the slippers as in diagram, thus bringing into action another opposing force due to the springing of the rails? This idea may not be deemed feasible by some minds, but I hold that any suggestion is worth putting in the scales to be weighed by competent judges.

Leslie A. Thain.

Buxton, *December 7th*, 1907.

I quite agree with Mr. Widlake's remarks regarding the probable results of attempting to stop a car by reversing the motors, but I think he has been a little hard on the motormen, as there are, I am afraid, a number of engineers, expert in other respects, who console themselves quite in ostrich fashion, that in the event of the brakes failing, the car can be stopped by reversing the motors. For instance, you evidently conceived this possible when writing the editorial in your issue of October 25th; and again, I notice in your review on Mr. Sayers's book on Brakes, in your issue of the 15th ult., the sentence "plus the power to reverse the motors." I do not know whether these are the words of Mr. Sayers or of your reviewer, but in either case why is an imaginary quantity added?

With reference to mechanical slipper brakes on single-truck cars, I suggest that these would be much more effective if fitted in front of both pairs of wheels, particularly in the case of top-covered cars having a high centre of gravity, for in that position an additional force would be available in the form of $m\frac{dv}{dt}$. In the editorial remarks I referred to, you lay stress on the importance of quick application of the brakes, a point which has not yet received the attention it merits, not only on account of the speed gained during application having to be neutralised, but also because of the fact that the coefficient of friction diminishes as the speed increases; in fact, if the speed is high and the rails are greasy, the braking effect of two wood blocks pressed on the rails is very slight. The braking value of the motors when shorted on each other is questionable; it would appear to vary between two points, the one not powerful, the other too powerful. Perhaps one of your readers would feel inclined to test it; if so, I suggest that he selects a rail which is in a very greasy condition.

A. Johnston.

Swansea, *December 2nd*, 1907.

[We think that Mr. Johnston should gather from our various articles that we strongly disapprove of the use of reversed motors as brakes. We agree with him that they ought not to be so used.

As trucks are built at present, the application of slipper brakes in front of the wheels is not easily accomplished, and Mr. Johnston's suggestion is impracticable, or at least undesirable, for other reasons.—Eds. E.R.]

Insurance.—A reader inquires for an insurance company that will take up the insurance of the globes of arc lamps used for public lighting.

Frequency Indicator.—The maker or selling agent for the "Goold" frequency indicator is inquired for.

Wrong Address.—A correspondent recently gave the address, 26, Loraine Road, Holloway; we replied by post, and our letter has been returned, marked "Not known" at that address. We trust that there has been some mistake; to ask for information whilst giving a false address would be a despicable act.

SOUND AS A MEANS OF CONTROLLING OPERATIONS AT A DISTANCE.

By JOHN GARDNER.

It has been the aim of the writer, in an investigation extending over some years, to secure to sound, over comparatively short distances, the same power of closing and opening an electric circuit at a distance as has been possible when using the ether as the medium between the transmitting and receiving stations, and it is claimed that a process has been discovered of attaining this object with sufficient reliability to form the basis of a new method of automatically governing actions at a distance without solid connections.

The conducting medium which is preferred, and in the employment of which the new system is likely to find its chief uses, is water, which is extremely susceptible to sound vibrations both in accepting such impulses from a generator, and in providing a path for their ready transmission. In the classical experiment of Colladon and Sturm on Lake Geneva, in 1826, a bell struck by a hammer and suspended only 1 metre below the surface was heard 9 miles away, the speed of sound in water being found at the same time to be about four times as great as in air. But where shorter distances are to be covered, or where a more powerful generator of sound is available, air is a practicable medium for the purpose in view.

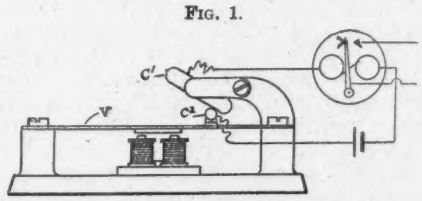
Since sound can be generated in a variety of ways, as by a bell in contact with the conducting medium, by a diaphragm electrically attracted and released, or mechanically, as by timed blows of a hammer upon the plates of a ship, the present system does not require that the sounds destined to bring about the desired operation shall be originated in any particular manner, but it is essential that, however caused, they shall have a definite and constant musical pitch, duration and interval. Moreover, it is necessary in some cases to provide that several sounds of differing pitch shall be simultaneously generated, and shall act at the same time upon the receiving apparatus, before a single circuit can be affected.

The apparatus at a sound-receiving station essential to the attainment of the required result—the governance of an

electric circuit—has proved to be of a simple character, consisting primarily of a vibrator, preferably in the form of a strip of steel tape, mounted by one or both ends upon a part, such as the plating of a vessel, which is exposed to the arriving sound. The vibrator partakes in this way of all the impulses reaching the ship's skin, but it being tuned to the distant sound, only the desired component is amplified by the sympathetic vibrations of the free portion of the strip to such a degree as to bring about the initial electrical action upon which all further effects at the receiving station depend. Even after amplification the disturbance of the strip is extremely small, no change of condition being perceptible with a strong magnifying glass.

Relays for telegraphic purposes are sometimes set so that the tongue or armature has a very small travel, $\frac{1}{1000}$ in. being considered a fine adjustment; but in the case in question a movement very much smaller is made use of for the same end—the opening and closing of a circuit. As no method of adjustment of contacts is applicable to such minute movements, the plan adopted is to mount a carbon pencil microphone upon the sound-receiving vibrator, and to give the pencil such weight and dimensions as will permit it to vibrate with the strip upon the reception of any note not corresponding with the natural period of the strip, but to remain stationary relatively to the vibrator when this is affected by a sound which it is prepared to amplify by resonance. With silence, or with an unsuitable note, the pressure of the pencil is therefore constant, but upon the arrival of a sound in agreement with the pitch of the vibrator, amplification follows, and the intimacy of contact between pencil and vibrator is diminished. Both these parts are in electrical circuit with a source of current of very low voltage and with the winding of the magnets of a relay, preferably polarised, of very high resistance, the relay being so adjusted that the full or normal current flowing during quiescence of the microphone is just sufficient to hold the tongue in the position in which, in ordinary telegraph work, the local circuit governed by the relay would be closed. A disturbance at the microphonic contacts, due to the arrival of the proper sounds, increases the resistance at that point, and the diminished current flowing through the winding of the relay is then unable to hold the tongue, which is released, and by moving to the opposite

Fig. 1.



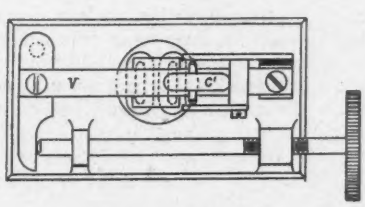


Fig. 2.

contact, closes the local circuit, which remains completed so long as the proper sound reaches the vibrator and the disturbance at the microphone continues. No vibration occurs at the relay itself, a sound lasting two seconds, for example, permitting the tongue to remain in the same position for this time, so that the fouling of the relay contacts which would follow such a high number of interruptions of the circuit as would be present with the note G (384), for instance, is avoided.

In fig. 1 v is the vibrator, securely fastened by its ends to a frame rigidly secured to the sound interceptor, say, the plates of a ship. The vibrator carries a weight, which may also be an armature to be acted upon by a magnet in circuit with a microphone, when it is preferred to use the circuit controller at a point remote from the sound receiving position. In fig. 2 one end of the vibrator is carried by a tension lever, by means of which the tune can be varied.

In circuit with the winding of a relay and a source of current are the electrodes c^1, c^2, the first being pivoted in a bracket insulated from the frame, and c^2 being attached to the strip. The increase of resistance takes place at the point of contact of c^1 and c^2, when v is disturbed by the appropriate sound, this resulting in the release of the relay tongue to complete the local circuit.

While a polarised relay is preferred, the relay may obviously take the form of an ammeter having a maximum reading slightly higher than the current passed by the

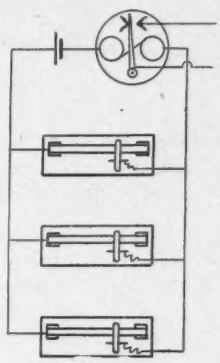


Fig. 3.

microphone when in the undisturbed state. The index of the instrument is, in this case, the moving contact for completing a local circuit by touching a fixed contact on the dial.

Where there are many interfering sounds, or where the noise at the receiving station is considerable, there may be several microphones in parallel through the winding of a single relay, and if three of these be mounted upon vibrators tuned to the notes C, E and G, for example, it will be necessary that all these notes reach the receiving apparatus at the same time before the relay tongue can be released to bring about the desired operation, a practicable amount of protection against disturbance being secured in this way.

Fig. 3 shows three differently tuned vibrators, all of which must be simultaneously acted upon before the relay tongue can be released.

It has been found that a far more sensitive receiver can be produced by mounting the microphone upon a part of the vibrator a considerable distance from a "loop," which in ordinary circumstances would have the greatest amplitude of movement. Damping of the oscillations of the strip is avoided in this way, and the current reduction is actually much greater than when the microphone is operated from a loop, while the natural period of the strip is less interfered with; in other words, an undesirable sound is less able to give rise to the ultimate operation. This apparently trifling detail is actually one of great importance, giving, as stated, sensitiveness to the desired sound and insensitiveness to improper ones, and it is hardly too much to say that the system has been rendered practicable by its adoption, coupled with the peculiar position of the carbon pencil in relation to the strip.

In its application to that branch of submarine signalling which consists of warning vessels of their position in relation to fixed points, such as lightships fitted with submerged bells, the system described should be useful in rendering the reception of the warning automatic, and thus further reducing the risk of accidents, as it will be practicable to sound a trembler bell on the bridge of a vessel, or even to blow the whistle, to inform the officer in charge that, notwithstanding any opinion he may have formed as to his position, his ship is in the neighbourhood of a danger point.

In finding the direction of a lightship, accurate comparison of the intensity of different sounds is also facilitated by the manual introduction of resistance in one or other of the circuits connecting the sound receiving portion of the vessel with the pilot house, while the current passing in one or both circuits is an indication of the distance from a sound generating station at the moment the apparatus ceases to act.

The operation of a printing telegraph instrument by sound transmitted from a distance will enable the officer in charge of a submarine to receive a message printed in dots and dashes from a surface vessel better able to look out than himself.

By the employment of a step-by-step motion subsidiary to the initial circuit-opening, several distinct operations may be controlled at the receiving station. An automobile mine or torpedo can be governed in this manner, and a model has been made in which the propeller is started and stopped, the rudder is put in any position, and an explosive charge is fired, any or all of these effects being obtained by the voice, singing the appropriate note in little more than a whisper, the operator standing some yards from the apparatus. It is literally true that the machine does what it is told. With a powerful generator of sound a distance of several miles is expected to be reached.

[We have seen and tested the model above-mentioned, and can vouch for the accuracy of the inventor's statements regarding it.—Eds. E.R.]

THE ELECTRICAL EXHIBITION, MANCHESTER, OCTOBER, 1908.

[The Meeting at Manchester.]

A meeting of the electrical trade, convened by circular, was held on Friday afternoon, December 6th, in the Board Room of the Manchester Chamber of Commerce, to consider the proposal for holding an exhibition in October of next year.

The Chairman of the Manchester Chamber of Commerce (Mr. E. H. Langdon) presided over the meeting, and there were present representatives of the following electrical firms:—Messrs. Berry, Skinner & Co., London; Messrs. A. Reyrolle & Co, Ltd., Hebburn-on-Tyne; the General Electric Co., Ltd.; Messrs. B. & S. Massey, Openshaw; Messrs. Steinthal & Co., Manchester; the Electric and Ordnance Accessories Co; the Lancashire Electrical Engineering Co., Ltd.; the British Westinghouse Electrical and Manufacturing Co, Ltd.; the D.P. Battery Co., Ltd.; Messrs. Mather & Platt, Ltd., Manchester; the New Brotherton Tube Co., Ltd.; Ferranti, Ltd.; Electromotors, Ltd., Manchester; Bruce Peebles & Co., Ltd., Edinburgh; Messrs. Parmiter, Hope & Sugden, Manchester; the Aron Electricity Meter Co.; the Liverpool Electric Cable Co., and Messrs. Drake & Gorham. Mr. C. S. Northcote, Mr. S. L. Pearce, Mr. Stubbs and Mr. Davenport were also in attendance. The German Consul (Manchester) was present throughout the meeting.

The chairman said: I may commence the proceedings by explaining to you how I came to take the chair to-day. A short time ago Mr. Pearce called upon the secretary of the Chamber of Committee, and explained that the electrical manufacturers of this district were desirous of holding an exhibition in Manchester, and that they thought it would be an advantage to have the support not only of the Corporation, but also of the Chamber of Commerce of the city. The matter was submitted to one of our committees, as we could not have a board meeting, the business being of a pressing nature, and that committee decided that the Chamber of Commerce should do all that it possibly could to further the object in view; and the president for the time being was requested to assist the promoters in their object, subject to certain conditions, which Mr. Pearce assures me will be fulfilled. The chief condition is, that the exhibition shall not be made into a sale room for articles to be taken away by purchasers; secondly, that there should not be—as there have been in many exhibitions—anything of the nature of "side shows," or entertainments, got up merely to attract the public and to bring in gate money, but it shall be an exhibition of purely scientific and practical appliances used in the various trades which employ electricity as a motive power or for lighting. I do not think I need occupy your time longer. But I must add one thing—I am quite sure there is no question of any promotion, or promoters, about this undertaking. It is a purely disinterested movement, except in so far as it is in the interest of manufacturers, who will send machinery, &c., for exhibition. The business before this meeting is: first, to approve of the scheme, as set forth in the circular; and, secondly, to elect representatives on the General Committee. You will see from the circular that five representatives are to be elected from among the general exhibitors—three are to be selected in Manchester, and two in London. I have great pleasure in moving from the chair:—"That the scheme for an Electrical Exhibition, as presented to the meeting in the circular, dated November 29th, be approved and adopted." Mr. Stubbs will second the resolution, and the question will then be open for discussion. Mr. Davenport will be pleased to answer any questions or give further information.

Mr. Stubbs said that, as representing the Engineering Section of the Manchester Chamber of Commerce, he heartily supported the scheme, and had great pleasure in seconding the resolution. The meeting would agree with him that there could be no better centre in the United Kingdom than Manchester for such an exhibition as was contemplated. It was a very important centre for manufactures of all sorts of electrical machinery, and time need not be wasted in recommending the scheme. He was very sanguine that, if the exhibition were held, it would be a great success. So far as the the Engineering Section of the Chamber was concerned, they might be assured that it had their cordial support.

The Chairman: I must apologise for one omission. After Mr. Pearce called upon me, I submitted his proposal to the Engineering Section, and they not only gave it their support, but recommended it to the General Committee of the Chamber of Commerce, stipulating, however, that, as a Chamber, they assumed no pecuniary responsibility. I now invite criticisms and suggestions on the general scheme.

Mr. Davenport, replying to questions, said that if the receipts from admissions and other sources were likely to prove insufficient, it would be for the Corporation, in conjunction with the organisers, to devise means. He did not think the Committee would go forward unless they were satisfied that there would be a sufficient income to ensure success.

The Chairman: The exhibition at Olympia, under the management of a similar committee, was a great success. They have that precedent to go upon. Every new exhibition profits by the experience of the past.

Mr. Bevis said there were guarantors for that exhibition. The position here was somewhat different. The committee might be sanguine, but it was well known that exhibitions sometimes resulted in deficits. It should be ascertained, first of all, how the expenses were to be guaranteed. The Committee would find it hard, if, besides giving their labour, they were saddled with a deficit at the close. Did he understand that the Manchester Corporation would make it good?

Mr. Davenport: No, I do not say that.

Mr. Bevis: The Manchester Corporation being the organisers?

Mr. Davenport: The position, I presume, would be this—if sufficient guarantors do not come forward to ensure success, the Corporation will abandon the exhibition. You cannot expect to have a cut-and-dried scheme without a guarantee fund.

Mr. Northcote said that up to the present funds had come in satisfactorily; but the Committee would not finally approve the scheme until success was assured.

Mr. Davenport, replying to Mr. Bevis, said that negotiations were in progress with regard to railway arrangements and space, but these matters could not be settled until the Committee was fully constituted and empowered to act.

Mr. Bevis thought their first object should be to get a working committee together, but much preliminary work had been done already.

The Chairman: The object of this meeting is to secure the general approval of the trade; and, as a natural corollary—the scheme being approved—you, gentlemen, will select three representatives from amongst the general body of exhibitors to serve on the Committee.

Mr. Davenport: And those representatives will not be asked to do anything until the Committee is fully constituted.

The Chairman: The scheme provides for a president. I understand that the Lord Mayor of Manchester has consented to approach a leading nobleman—a large landowner in this district—with an invitation to act as president. The name of the nobleman cannot be made public until his assent has been obtained.

The resolution, moved by the Chairman, and seconded by Mr. Stubbs, was put to the meeting and carried unanimously.

The Chairman then invited the meeting to nominate three gentlemen from amongst the general body of exhibitors to serve on the Committee; but before a vote was taken upon this point, Mr. Dunlop, of the British Westinghouse Co. (who had just entered the room), was asked to state his views.

Mr. Dunlop promised, on behalf of his company, very hearty support to the scheme. They much preferred, he said, to have an exhibition in Manchester, rather than in London; and Mr. Pearce and Mr. McCowen deserved the support which he believed manufacturers were prepared to give them, and thanks for the part they had taken in promoting the scheme. Mr. Bevis had very wisely raised the question of funds. It was of interest to manufacturers how much their liabilities would amount to in a scheme of this kind, but these proceedings, he understood, were to be regarded as preliminary.

The Chairman: That is so.

Mr. Dunlop: We are prepared to do whatever we can, within reason, to co-operate with other electrical manufacturers in this district, to make the exhibition a success. That is all I need say at present.

The three gentlemen nominated to serve on the committee as representing the general body of exhibitors, were Mr. Longbottom, of Electromotors, Ltd.; Mr. Bevis, of the General Electric Co., Ltd.; and Mr. Dunlop, of the British Westinghouse Co.

The names were unanimously approved by the meeting.

The Chairman said he did not think the meeting could proceed further that day, and he thanked those present for their attendance, at the same time assuring them that the services not only of the Engineering Section, but that of the general staff, of the Chamber of Commerce would be at their service in furtherance of the scheme.

The thanks of the meeting were voted to Mr. Langdon for his services in the chair, and for his hearty co-operation. The help of the Chamber of Commerce, Mr. Davonport said, was much valued by the organisers.

This concluded the business.

A site for the intended exhibition has not yet been chosen, but the organisers have two or three available pieces of land in view.

The space required will be about 100,000 sq. ft., and the most advantageous site, having regard to railway and other accommodation, will be selected.

Another meeting, presided over by Sir Wm. Preece, was to be held in London yesterday (Thursday), December 12th, at the Hotel Cecil, when two gentlemen, representing the trade in the London district, were to be chosen to join the General Committee.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Reflector Shades.

Mr. F. J. Tiffin, of 3, Great Winchester Street, E.C., is supplying a new protected fitting and silvered-glass ("Everbrite") reflector shade. Hitherto these reflectors have been provided with a glass neck and metal carrier, with three screws and 1½-in. hole to fit on to bayonet holders. For inside use this has given satisfactory results, but for outside service, and especially for service on railway and tramway cars, the risk of the glass neck breaking or the screws working loose, in consequence of the vibration, has been great. This fact has led to the introduction of the new fitting, by which all the risk of breakage is stated to have been overcome.

The fitting is in polished aluminium, and we understand that it is easily fitted, being made in two pieces, one of which is passed through the inside hole of the reflector, the dome piece resting on the outside; the lamp-holder is passed through the fitting and securely fastened by means of the shade-carrier.

Victor Arc Lamps.

The accompanying illustrations show the external appearance and the mechanism of the "Victor" enclosed D.C. arc lamps, which are being introduced by the Electric & Ordnance Accessories Co., Ltd., of Stellite Works, Aston, Birmingham. These lamps

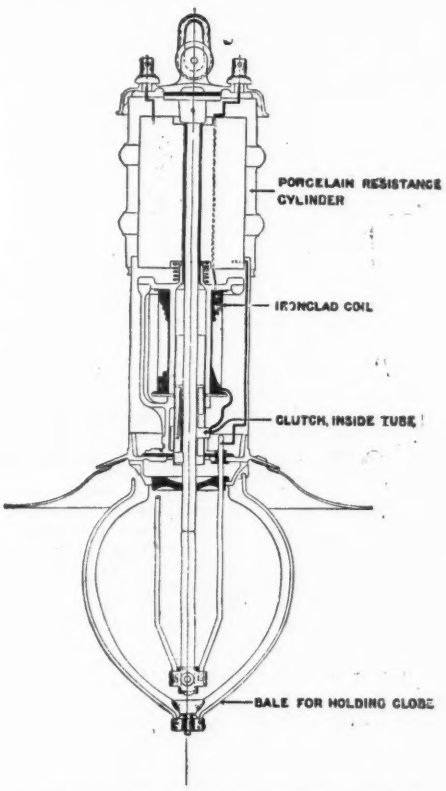


Fig. 1.—Mechanism of Standard Lamp.

have been standardised in three forms—the "Standard," "Miniature," and "Flame" lamps, and have been designed with a view to securing the utmost simplicity of construction, interchangeability of parts, and excellence of workmanship and material.

The mechanism contains no clockwork, shunt coils, or dash-pots, and there is only one moving part. The "Standard" lamp burns for 100 to 140 hours without re-trimming, and is easily trimmed and cleaned. The insulation is suitable for high-voltage circuits, and the voltage across the arc, it is claimed, is unusually high, giving a high efficiency.

The one moving part is contained inside a sealed tube, and the arrangement of the parts is practically symmetrical round a central tube. The coils are impregnated so as to be impervious to moisture, and there is no regulating mechanism. The lamp is suitable for burning either singly, on circuits up to 125 volts, or in series with others of the same make, and the "Standard" type is stocked in only one size, taking 5 amperes. The line resistance, which consists of Eureka wire wound on a glazed porcelain cylinder, is

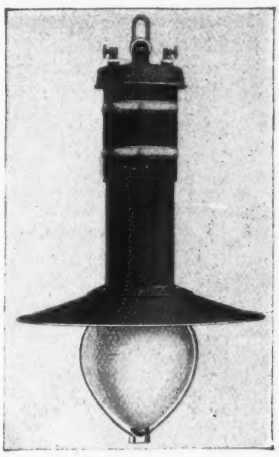


Fig. 2.—"Standard" Lamp.

contained within the case; the coil is self-contained, and is connected with the clutch by a copper flexible, but the grip is of steatite, and therefore carries no current, so that it cannot be injured by sparking. The upper part of the case slides down over the lower part when it is desired to inspect the interior, and the whole of the case is insulated from the circuit.

The globe is of special design, only the lower two-thirds being opalescent, and the upper third clear glass; thus the upward light from the arc has an uninterrupted path to the globe support and reflector, which are white enamelled, giving the maximum efficiency

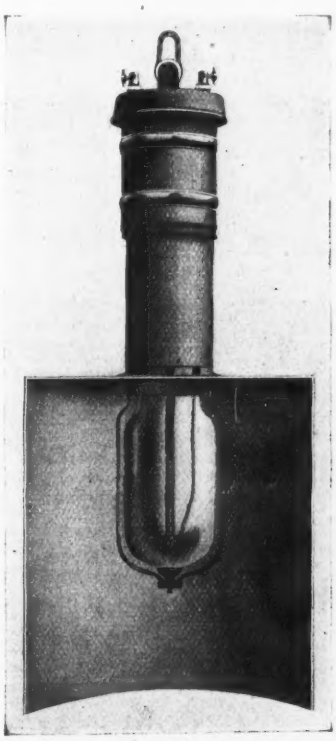


Fig. 3.—Photographic Lamp.

of illumination. Air ducts are provided in the base, round the case, and under the crown of the lamp, giving ample ventilation The carbons are both of the same diameter, and the stump of the upper carbon is just long enough to be used for the negative when trimming.

Fig. 1 shows a section of the Standard lamp, and fig. 2 the complete lamp; fig. 3 illustrates a special pattern used for photographic purposes. In the latter an arc 1 to 1½ in. long is employed giving a violet light, with special carbons.

Paraffin-Electric Motor Sets.

The Seal Motor Co., of Old Mill Lane, Hammersmith, London, W., are constructing some small generating sets driven by a paraffin motor. The engine is of their usual standard pattern with inverted cylinder, specially constructed to use paraffin, and is fitted with tube and H.T. electric ignition. After running for a few minutes on full load, the engine will fire itself automatically. The engine is direct connected to the dynamo, and gives an output of about 1·2 kw. We are informed that the set can be started from cold in about 6 minutes, and is specially suitable for charging accumulators, small country house lighting plant, and for abroad. If desired, the engine can be started straight away on petrol. An illustrated leaflet relating to the set has been issued by the company.

New Telephones, &c.

Amongst the new apparatus recently brought out by the Sterling Telephone & Electric Co., of Upper Thames Street, E.C., the devices illustrated herewith are of interest.

Fig. 4 shows an inter-communication battery wall telephone, in which the switch contacts and line terminals are fitted at the back,

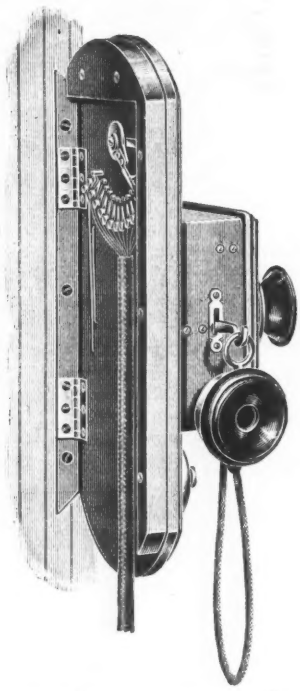


Fig. 4.—Sterling Inter-communication Telephone

where they are well protected from dust and rough handling. To facilitate access to these parts, the whole instrument is attached to a fixing batten by means of hinges, so that it can readily be "opened" for inspection, &c. The switch contacts are so constructed that it is impossible to make contact with two lines at once.

Fig. 5 shows a single-lever automatic inter-communication battery telephone, which is provided with a patent automatic replacement device of great ingenuity. Thanks to this, the line selector need not be moved except when originating a call; calls may be received and answered no matter what the position of the

Fig. 5.—Single-Lever Automatic I.-C. Telephone.

selector, and when a conversation is finished, the act of replacing the receiver automatically disconnects the switch.

A neat little mine exploder is shown in fig. 6; this consists of a high-pressure generator with three laminated magnets, provided with ratchet and free-wheel gear. The whole weighs 6 lb. 10 oz., and is capable of exploding from 1 to 12 cartridges in parallel at one discharge, by giving the handle a sharp half-turn to the right. The pressure produced is about 200 volts, and the apparatus measures only 7 × 3¾ × 6 in. over all. The interior of the exploder is shown in fig. 7.

Besides the devices illustrated above, the company has brought out an extra loud-ringing electric motor bell for works, ships, &c.; it is worked by the ordinary D.C. electric lighting circuit, and produces a deafening clatter. The gong weighs 60 lb., and the whole thing about 100 lb. One of these bells is mounted in the company's showroom, where also a unique collection of telephone and allied apparatus may be seen.

The "Black Cap" Lamp.

The Edison & Swan United Electric Light Co., Ltd., are making a new type of lamp, which they have named the "Black Cap." The lamp bears the "Royal Ediswan" trade mark, and is further distinguished by an illustration of a bird, and the words "Black Cap" etched on the bulb. We are informed that the lamp has been placed on the market to meet the demand for a high grade lamp, of standard pattern, suitable for use in all exposed situations, where the ordinary type would be unreliable owing to

Fig. 6.—Sterling Mine Exploder.

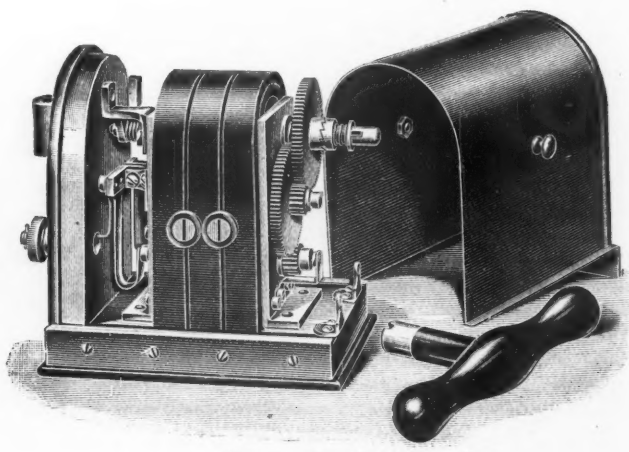


Fig. 7.—Mine Exploder, Open.

corrosion from damp or chemical fumes. The lamp is claimed to be specially suited for use in such places as mines, chemical works, breweries, laundries, cellarage, and all similar places where the lighting apparatus is exposed to either damp or fumes which would have a corrosive effect on the lamp caps, if left unprotected with the exception of the ordinary lacquering.

The cap of the new type is enamelled with an acid and waterproof enamel of high flexibility and insulating qualities, and in addition to the protection thus afforded, the cementing of the cap to the bulb is effected by means of a waterproof cement, thus rendering the lamp absolutely impervious to moisture or fumes. For outdoor use, such as street lighting, no special precautions are necessary to render the fitting weatherproof. It is claimed that in all details regarding insulation, the lamp more than conforms to the standard requirements.

LEGAL.

Prosecution under the Coal-Mines Regulation Act.

At the Gateshead-on-Tyne Petty Sessions, on the 5th inst., John Straker Nesbit, manager of the Marley Hill Colliery, was charged with having failed to cover up certain "live" parts of electric switches, in contravention of the Coal Mines Regulation Act.

Mr. R. S. Holmes, who prosecuted on behalf of the Treasury, said the case arose in connection with a small electric motor. The switch-handle was of vulcanite, but close to it was a piece of "live" copper, which was unprotected. The machine was delivered at the mine on August 20th, and on August 21st, whilst a man named Willis was manipulating this handle, he touched the copper and was killed.

Mr. T. Lambert, who defended, said the management had done all in their power to enforce the rules. The man who was killed was experienced in the working of electric machines, and there was no need for him to touch the uncovered copper, and if the necessity had arisen, a pair of rubber gloves was provided. The management, therefore, thought they had done all that was necessary.

Mr. Holmes said the precautions taken would have been all right had the place been a machine-room.

Mr. Lambert said they thought the place would have come under that definition, but the Inspector of Mines ruled otherwise. The "live" parts had now been covered up to the satisfaction of the Inspector.

A penalty of £5 and costs was imposed.

Electric Tramways and their Rights.

On Wednesday last week, in the King's Bench Division, Mr. Justice Bray had before him the case of the Rhondda Urban District Council *v.* Taff Vale Railway Co., which came up in the form of a special case.

Mr. Eldon Bankes, K.C., and Mr. Goldberg appeared for the railway company, and Mr. Bailasche for the Council.

Mr. Bankes said this was a special case stated by his learned friend Mr. Abel Thomas, K.C. The Council obtained powers to construct a tramway along certain roads, and in some portions of their course these roads crossed the line of the railway company. The roads crossed the railways at right angles, and at varying heights from the ground there were a great number of telegraph wires. It was left entirely to the Council to say what form of traction they should adopt, and they had adopted the trolley system. There were Board of Trade regulations which, unless modified, required that the live wire should be 21 ft. from the ground, and the protecting wire a few feet above it. The telegraph wires which crossed the railway bridges were not a sufficient distance from the ground to enable the cables to pass under, and the Council thought that there were sections under the Tramways Act which enabled them to deal with the situation which thus arose, and they claimed that, as there was a difference between the railway and themselves, the point should be settled by arbitration. The point at issue was whether the Council were right in saying that their case came under Sec. 30 of the Tramways Act or not. Counsel's point was that the Council had misconceived their powers under the Act. The question for the decision of the Court was, was the arbitrator right in deciding for the Council and saying that this case came under the Tramways Act and not under the general powers? Counsel stated that the Land Clauses Act was incorporated in the Council's Act. He argued that the case did not come under the Tramways Act, and that the Council had no power to do the work themselves at their own cost and go upon the land of the railway for the purpose of carrying out that work.

Mr. Bailasche argued the case for the Council, and submitted that the decision of the arbitrator was right.

His Lordship, in giving judgment, said the contention of the Council was that the true construction of the sections in the Act entitled them to alter the telegraph wires without calling upon the railway company to do so, and at the cost of the Council. The question, however, was whether this was within the meaning of Sec. 30 or not. The section said that "for the purpose of making, laying down or constructing tramways, the promoters may, as far as necessary, alter the position of all wires or apparatus for telegraph." Mr. Bankes had contended that that power did not lie with the Council. His Lordship, however, thought the contention of Mr. Bailasche the correct one—that it would be expedient for the Council to do the work. The true construction, therefore, of Sec. 30 was that contended for by the Council, and therefore he expressed the opinion that the Council were entitled to alter the position of the wires at their own expense. Mr. Bankes had pointed out certain restrictions, but his Lordship thought that, the Council having given them power to alter the wires, this enabled them to go upon the railway company's land to make the necessary alterations. He therefore decided in favour of the Council, and gave them the costs of the case.

Mr. Bankes said, as the matter was of considerable importance, he asked for a stay of execution.

His Lordship: I have been rather surprised that the railway company should not be willing for the Council to do the work. I refuse leave to appeal.

Norwich Corporation *v.* Norwich Electric Tramways Co., Ltd.

Before Mr. Justice Bray, in the King's Bench Division of the High Court, on Thursday last week, the case of Norwich Corporation *v.* Norwich Electric Tramway Co. came before his Lordship on the question as to the construction of a certain section of the Norwich Electric Tramways Act of 1897.

Mr. MacMorran, K.C., on behalf of the Corporation, said they were seeking to recover a sum of money they had spent on repairing a certain junction, and the question was whether they were entitled to recover under the Act. A dispute arose between the Corporation on the one hand, and the Electric Tramway Co. on the other, as to what was the duty of the company under Sec. 57 Sub.-Sec. 5 of the Act. In the first instance, they brought an action to recover the money, and that action was tried before Mr. Justice Phillimore at Norwich, and he gave judgment for the plaintiffs, the Corporation. The action was brought to the Court of Appeal, and the Electric Tramway Co. took the point that there was no right of action because the junction should have been repaired under the section in question.

Mr. Danckwerts, K.C., for the defendants: The point was that there was no jurisdiction.

Mr. MacMorran said application was made to the Board of Trade who appointed an arbitrator, and he stated the case which was used before the Court. Mr. Littleton was appointed arbitrator, and they had now to ask his Lordship whether the construction applied by Mr. Littleton was right or not. The arbitrator, as a matter of law, awarded and declared that the Corporation should recover from the company £320, as the expenses incurred, with interest at 5 per cent. If his inferences of law were incorrect, he awarded and declared that the Corporation should recover nothing from the Electric Tramways Co., and that the Corporation pay the company's costs of the arbitration. Mr. MacMorran contended that the construction put upon Sec. 5 was the correct one, and that the company ought to pay.

Mr. Danckwerts, K.C., for the Electric Tramways Co., contended that the arbitrator was wrong in his construction of the section.

His Lordship, in giving judgment, said the case was not free from difficulty, but he came to the conclusion that he must decide in favour of the Corporation. He held that the law as laid down by the arbitrator was correct, and, therefore, he gave judgment for the plaintiffs, with costs.

Metropolitan Electric Supply Co.'s Assessment.

On Friday, in the King's Bench Division of the High Court, the case of the Metropolitan Electric Supply Co. *v.* The Assessment Committee of the Metropolitan Borough of Paddington, and the surveyor of taxes for the district, comprising the parish of Paddington with the said borough, came up before Mr. Justice Bray on a special case stated by the arbitrators.

Mr. Danckwerts, K.C., Mr. Avory, K.C., and Mr. Bydell Houghton appeared for the appellants (the Metropolitan Electric Supply Co.), and Mr. C. A. Cripps, K.C., and Mr. W. C. Ryde were for the respondents.

The appellant company were formed to supply electric energy under the Metropolitan Electric Act of 1889, and occupied certain hereditaments known as the Amberley Road Electric Lighting Station and certain mains, wires, and other electrical apparatus in the Borough of Paddington. The appellants appealed to the General Quarter Sessions of the Peace for the County of London against the valuation made on May 23rd, 1905, whereby the applicants were assessed as occupiers of the premises in Paddington, at the gross value of £24,584 and the rateable value of £17,976.

By an agreement of April 2nd, 1907, between the appellants, the respondents and the surveyor of taxes for the district, it was agreed that the appeal should be referred to Mr. Alfred Littleton as arbitrator.

Prior to July 5th, 1904, the appellants carried on as part of their undertaking on their premises other than Paddington, an electrical undertaking and business in Marylebone. On July 5th, 1904, an agreement was made between the appellants and the Marylebone Borough Council for the transfer by the appellants to the Council of Marylebone of the undertaking for the temporary supply of electricity as agents for the Council to all consumers in the borough from (1) the date of the agreement to March 31st, 1905; (2) from March 31st, 1905, to March 31st, 1908.

The appellants contended that in valuing the undertaking the circumstances that the Marylebone undertaking was before March 31st, 1906, in process of being severed, and was at that date to be wholly severed from the appellants' undertaking, should have been taken into account.

It was contended by the respondents that the valuation must be made on the basis of the published accounts of the appellants for the year 1904, that the fact of the partial severance referred to in the Marylebone undertaking, which would be completed in March 31st, 1906, should not be taken into account, and that the only materials relevant for the consideration of the Assessment Committee in this connection were the published accounts for 1904. The respondents further contended that the machinery of the provisional supplemental lists were designed to meet, and did meet, any grievance which might arise from the alteration of the circumstances in making the valuation list by the overseers.

The arbitrator held that the contention of the appellants was right. If he was right in so holding, then he found as a fact that the assessment appealed against would be reduced to £21,377 gross value and £11,076 rateable value, and he directed that all costs which were in his discretion should be paid by the respondents to the appellants.

After hearing arguments on both sides, Mr. Justice Bray said he agreed with the contention of the appellants that the arbitrator was right in holding that the contention of the appellants was good law. He, therefore, decided in favour of the appellants, and allowed the costs of the argument.

Bellamy v. The Wakefield and District Light Railway Co., Ltd.

In the Chancery Division of the High Court on Friday, before Mr. Justice Joyce.

Mr. Younger, K.C., mentioned this case, which was a motion to restrain a nuisance. The case had been adjourned from time to time in order that the parties might have an opportunity of coming to an arrangement in regard to the matter. A complete agreement had now been arrived at, and the nuisance had been entirely got rid of. The only order he asked his Lordship to make was that the costs of the plaintiff should be taxed.

His Lordship made the order asked for.

The Brown Patent Appeal.

[*In the matter of the Patents, Designs and Trade Marks Acts*, 1883 *to* 1888, *in the matter of Letters Patent, No.* 1,434 *of the year* 1899, *granted to S. G. Brown.*]

This case came on for hearing in the Court of Appeal, consisting of the Lord Chief Justice, Lord Justice Buckley, and Lord Justice Kennedy on Wednesday, 4th inst., on the appeal of the petitioners from a judgment of Mr. Justice Neville, in the Chancery Division, on March 11th last. In this case the petitioners petitioned for the revocation of the letters patent in question on the ground of want of novelty, utility, and subject matter. The letters patent were granted to Mr. S. G. Brown "for improvements in telegraph apparatus," the invention consisting in a relay for retransmitting messages received through cables and an apparatus used therewith. In May, 1906, A. Muirhead and Muirhead & Co., Ltd., presented a petition for revocation of the patent which was served on the owners of the patent and their licencees, the Commercial Cable Co. The usual grounds of invalidity were alleged at the trial, and a number of prior publications were discussed and evidence was also given as to common knowledge.

Mr. Justice Neville, after a nine days' hearing, on March 11th last, held that the petitioners had failed to establish any of their objections to the patent, and dismissed the petition with costs. Hence the present appeal of the petitioners.

Sir Robert Finlay, K.C., Mr. Cripps, K.C., Mr. A. J. Walter, K.C., and Mr. F. Sinclair (instructed by Mr. Alfred Withers) appeared for the appellants; Mr. Bousfield, K.C., and Mr. J. C. Graham, K.C. (instructed by Messrs. Trinder, Capron & Co.), were for the respondents on the appeal; and Mr. E. Russell Clarke (instructed by Messrs. Budd, Johnson & Jackes) appeared for the Commercial Cable Co.

The case was opened by Mr. Cripps.

Judgment was delivered on Monday morning, when the Lord Chief Justice said they were asked to over-rule the judgment of Mr. Justice Neville who had declined to revoke a patent that was granted to Mr. Brown in the year 1899. The case was one of considerable difficulty, and but for the fact that they had the most clear and exhaustive arguments from Mr. Cripps and Mr. Walter, and had heard Mr. Bousfield on the one point on which they had any doubt, he certainly should have had much more difficulty in arriving at the conclusion at which he had arrived from the various points which had been pressed upon him. The petition was for revocation of a patent in connection with complicated machinery to improve the transmission of cable messages, and was presented by Mr. Alex. Muirhead and Muirhead & Co., Ltd., and he need hardly say that in connection particularly with ocean telegraphy, there were few, if any, more experienced than the gentleman who held the honoured name of Muirhead. That, in his opinion, was a very important matter in connection with certain evidence given in this case. This invention related to the sending of signals by electricity, and principally through long sea cables. He did not propose to refer at length to the existing state of knowledge, he adopted and they seemed to him to be very admirably and clearly stated, the statements which were made by Mr. Justice Neville at pages 342 and 343 of the Reports of Patent Cases, Vol. 24. He wished, if he might be allowed to say so, that he adopted them as his own, and did not wish to repeat them as he could add nothing to them. He adopted them as the basis of his judgment, supplemented by one or two observations he had to make. Those observations of Mr. Justice Neville were contested and criticised by Mr. Cripps and Mr. Walter from two points of view. It was first said that Mr. Justice Neville had attached too much importance to what had been called the success of Mr. Brown's invention. He had pointed out how no less a sum of money than £7,000 per annum had been paid by competent and experienced people in order to use Brown's invention, but it was said by Mr. Cripps, and particularly by Mr. Walter, that success did not depend on that which Mr. Brown had found out, but upon the beauty of the manufacture of his instruments, and on his using in those instruments things that were not covered by this patent, which were perfectly well known, and were merely the things which were used for the purpose of making these instruments extremely efficacious and satisfactory. Secondly, it was said Mr. Justice Neville had confused discovery with invention, and the evidence to which attention was called, and of which various passages were read, went to show that what Mr. Brown had purported to claim as his invention, was only the latent property of a known and existing machine; and without invention, he had called the attention of the electrical world to the fact that that property existed, and could be utilised with those machines. If either of those two points had been made out satisfactorily, a very serious attack had been made on the validity of certain claims to which he referred in detail. He had thought it his duty to go through the evidence in consequence of what Mr. Cripps and Mr. Walter had said, and he did not find that any one suggested that the work done by what was alleged to be new in those inventions, was, in fact, performed by other parts of the machine. Of course he was aware that it was said the new things are only discovered, but that was a different point. He did not find anywhere any suggestion made that that for which the cable companies were paying Mr. Brown was not the use of what he would call the two important parts of the machine, that was to say, that which was the subject of the claim for shunting the receiver by means of the closed magnetic circuit, and the curing of what had been called the varying zero by having a very sensitive tongue, which was very obedient to the signals that came, and gave them a sharpness at the beginning and brought them to an end with accuracy. They were dealing with some of the most delicate of scientific instruments. The history of electrical engineering would tell one that the difference between success and failure was sometimes extremely small, and that for years failure existed and attempts at success failed because the very smallest points were overlooked, or thought to be immaterial. It seemed to him they had only to look at the history of this case, to say it was quite impossible to come to the view that Mr. Justice Neville was wrong in the importance he attached to that part of the evidence, which he called very properly the history of the case. He wanted, as part of his judgment, to refer to Mr. Swinburne's evidence, from which it appeared that Cromwell Fleetwood Varley was working on this project, as the specification showed, for many years; that Lord Kelvin had been working on it; that Delany, a man of brilliant scientific electrical attainments, had been working at it, and that Muirhead had been working at it himself.

Having made these observations, his Lordship then went into the particular parts which were attacked, and to the particular questions on which they were asked to say that this patent was bad. He had already indicated the class of difficulty. The difficulty was that at the end of a very long electrical cable, the current came out very weak, in consequence of the distance it had to travel. He only used the word "current" because it was the word which had been used. In consequence of that, though messages could be received, and even if, by means of the siphon recorder or any other delicate receiving instrument, a message was recorded, that message could frequently be read, it was agreed that the current was not strong enough to transmit that message itself, so to speak, was not strong enough to transmit that message to another electrical apparatus, and it was also very important for accuracy of work that it should be reinforced by what was called a relay current.

Proceeding, the Lord Chief Justice said: Now, for my purpose, all I need say about relays is this—and I think I shall be charged with using perhaps very common language, and I daresay I shall make mistakes in the way in which I express the matter—the function of a relay is to bring into operation a stronger current which is operating in the local relay circuit. The weak current puts that relay into operation by closing the circuit and so allowing the stronger current to flow or operate, and then that stronger current, with its increased strength, gives the signal on the receiving instrument—not, of course, transmitting it, because, in this case, it is not a question of transmitting, it operates upon the receiving instrument. It is agreed that although, with the weak current, the message can frequently be read, and though with the specimens that were shown to us you could read messages fairly well that came through; it is agreed that when you come to operate a relay by means of a weak current it is extremely important that the neutral zone as it is called, and I daresay rightly called, a varying zero, a straight line on either side of which the wave or

indication of the signal would be given, should be as steady and as constant as possible. Therefore, when you come to deal with working through relays, it has been known for a long time that there is this difficulty of keeping what is called the zero in a constant position, preventing its being a varying zero; or, with my less well-informed mind, I should speak of it as being to keep the line straight on either side of which the signals appear. It is in that connection that I think it is very important—indeed, with reference to many of these claims—to take Mr. Muirhead's own statement of what was the state of knowledge in January, 1899, which is the month in which the two patents came out. He says in his provisional specification of January 9th: "As will be understood, the actuation of one or other of these relays effects the transmission or re-transmission of the received signals. It has been attempted before to utilise the signal coil of Kelvin siphon recorders to operate relay tongues, but unsuccessfully, owing to the fact that the necessary firmness of contact for local circuit working was not attained, and also by reason of the difficulties in overcoming without great loss of speed, the inertia of the extra mechanism which the arrangement entailed and in maintaining the zero of the combination." Could there be a more striking suggestion that all Mr. Brown did was to take an old machine and discover its use and patent that, than that statement of one of the experts of telegraphy himself, the petitioner? I said in the course of this case, and I repeat, greatly as I value the assistance rendered to the Court by such witnesses as Mr. Swinburne and Prof. Silvanus Thompson (I am aware that their power of criticism is great in a case of this kind), to my mind the evidence of Mr. Alexander Muirhead, who must have presumably been in Court, or if not sitting in Court, was, at any rate, at the end of a telephone wire that is not putting him too far off, would have been worth a great deal more than the criticism of those who have criticised this patent. I say there is no more striking comment on the suggestion that this is merely a discovery of what was (I will not use terms that may be thought to be too strong) what any competent man would have understood than to find that in January of that year Mr. Muirhead is stating the difficulties in the way, which we know by the evidence have existed, and when you put that on the top of the years of working of such men as Varley, Kelvin, Delany and Muirhead himself, it really does show that there was a most serious problem to be solved. Mr. Brown has purported to have solved it by two things; he has purported to say, I have improved my contact so that I get greater sensitiveness of the moving tongue to the signal that it ought to regard. I get a sharper signal at the beginning, I get a more clear determination of the signal at the end, and I get an instrument which is enabled to reproduce the impression of the signalling current, and to disregard the weak current through the cable itself, due to earth currents and due to those mysterious things which I do not suppose any electrician, however expert he was, could really and thoroughly explain. I now come to the specification itself, and in the light of that which was known, I have now to consider what Mr. Brown told the public, and here I am able, to a very large extent, to shorten what I have to say, which it is not necessary to prolong by reference to Mr. Justice Neville's judgment.

(To be continued.)

[The appeal was dismissed, with costs.]

A GENTLE REMINDER.

[COMMUNICATED.]

ANY person acquainted with the facts, and gifted with a modicum of commercial insight, must admit that there will be settled in the near future a question of importance to all engaged in electrical work: the question, namely, whether gas shall become the artificial light and heat of the many, and electricity become, or shall we say remain, the luxury of the few. And any such person, of a not too optimistic temperament, will further admit that the issue is, to say the least, doubtful.

What has brought electricity to this disgraceful pass? If we admit that it is inferior to its competitor, we have done with the matter; but none of us are going to do that. We are all ready to prove at a moment's notice to any comer or lay person, its inherent and actual superiority. Electricity has had the benefit of daily popular advertisement; the curiosity of the vulgar about its possibilities is unlimited; they believe that most modern "miracles of science" are accomplished by its aid; the one thing they refuse to believe about it is that it will light and heat their homes and cook their food pleasantly and economically.

We, better acquainted with its little ways, know that it will do all these things. Why, then, have we failed so dismally to impart our faith and knowledge to the public?

Just consider one small fact. We are ready, some of us, to prove by all manner of means, theoretical and practical, that the glow lamp, properly used, is better, all things considered, as an artificial illuminant, than the gas mantle. Now the superiority of the latter over the flat-flame burner is simply overwhelming. Yet the flat-flame burner was our only competitor for very many years; and how much damage did we manage to do it in the time? Not we, but Welsbach proved fatal to it. The common plea is that the cost of wiring has always been against us. But how many of existing houses, more particularly of the smaller sort, were built in the days of flat-flame burners and electric light? A very considerable proportion, I should say. And how many were wired? And if not, why not? Any candid person must lay a large share of the blame at the door of the men in charge of electric lighting.

To people of a certain degree of elevation in the social scale, a tailor is a tailor; just that, and nothing more. He may practise his art in a house in a back street, with a card in the window; he may style himself grandiloquently, and cover a shop with giant gilt letters, fill large plate-glass windows with beautiful wax models and big plain figure cards; he may receive his "clients" on a pile carpet, behind a window furnished with polished wood and a few decorous rolls of cloth, but a tailor he is, just that, and nothing more. It may surprise and amuse persons of the above-mentioned elevation to discover that there are certain ways of getting business which a "high-class" tailor would not condescend to adopt; his dignity would suffer thereby, though his business might benefit.

Now supply engineers, as they are at present situated, are where they are to extend electric lighting to its utmost. The "high-class" tailor might lose his "high-class" clients if he adopted business methods of a more popular sort; the supply engineer is in no such danger. Whether he like it or not, he is there to earn money for his company, or to try to prevent a deficit for his municipality, and he is merely rather ridiculous when he stands on what he conceives to be his dignity. Instead of believing that the man who can read Heaviside (if he can) lowers himself by descending to commercial considerations, he should believe that he, having a mind capable of mastering the theory (granting he has), can very easily learn the simple secrets which have made rich men of quite stupid persons.

The mantle is daily improved, inverted burners are introduced, gas-cookers and stoves are pushed with unlimited energy, but the engineer is still in many cases almost entirely absorbed in what he probably considers the higher branches of his work; assuming that he considers business-getting a branch of his work at all. If he ever thinks of the selling part of the matter, it is to devise new, marvellous and intricate tariff systems. We may grant that the results frequently do credit to his ingenuity; the question is, whether the latter is not misplaced. However gleeful the deviser may feel, the public simply feel suspicious. The gas people's shop window has its goods marked in plain figures; the electric light salesman gives the impression of taking stock of his customer and putting on the top price that he thinks he can get.

A plain flat rate anyone can understand; with patience and perseverance the public might be got to understand the accurate fairness of the demand system; but in many towns the patience and perseverance have not been forthcoming, and the suicidal offer of alternative flat rates stultifies the supply authority in the eyes of the public.

In one important station where an alternative flat rate was recently offered, there was sent round to consumers a circular, which elaborately explained to them the arithmetical process by which they could discover whether it would be advantageous to be charged on a flat rate. In other words, the supply company said to the consumers, We have charged some of you too much in the past; we are ready now to charge you a fair price; we leave it to you to discover which of you have been the sufferers; those of you who are not adepts at arithmetic will continue to be swindled.

An all-round demand system may puzzle the public, but it does not make it suspicious; a system of classification of consumers gives rise, in all but those who pay cheapest, to the same unpleasant sense of being "done," as the variation in the price of programmes in the different parts of a theatre.

Radiators and cookers are being thrust upon the lighting engineer by the manufacturers. He explains to the public that it must either pay 6d., or some such exorbitant sum per unit, or put down a handsome sum for rewiring. In some towns where coal is dear, lighting units are being sold at a profit, at the same price as "cheap" power is being offered at in other towns.

The manufacturers are agreed that the present depression is due to price-cutting; in other words, for some time electrical appliances have been offered to the public at less than they can be made for in a free trade country, to be sold at a profit. What has been the manufacturers' loss should have been the engineers' gain. New York consumers use I don't know how many times as much current per head as London. I have heard this attributed to the number of lifts in New York!

I don't think I could buy a bad gas-cooker if I tried; the gas company takes care that the public gets a first-rate article, which does not light back, or do any of those unpleasant things which it might easily do if badly designed. But if the public buy arc lamps, they are more likely to buy them bad than good. Probably the shoddy, badly designed arc lamp has done more utterly unnecessary harm to us than we can guess.

It is impossible to argue with a man who is satisfied with things as they are. But if it is possible to prove that, unless he bestirs himself, things will get worse, it is conceivable that he may be galvanised into life.

What then, does my ideal "live man" do? To begin with, he throws tariff fads and fancies overboard; he selects a demand system, with cut-out switches where necessary; or a two-rate, or a double flat rate for power and lighting, with sub-meters for small power consumers; but what he selects he sticks to; alternatives are offered over his body. He then takes infinite pains to explain in the simplest possible manner to each consumer the method he adopts, and the fairness of it. He employs a good class of man and trains him to advise the consumers how to use their current in the most efficient manner possible. He knows that the public will buy arc and glow lamps on price, if left to itself; so, while scrupulously avoiding favouritism, he gets his large consumers to look to him for advice in their purchases. His meter readers carry a portable ammeter by which they can give ocular demonstration to any consumers who are using old or inferior lamps, of the bad economy of their ways. His meter readers are ready to alter a two-light fitting at any time free of charge, to take two metallic filament lamps in series; they don't wait to be asked, but proffer the suggestion.

The meter readers are not required to carry the equipment of a German soldier; but an electric kettle or curling-iron heater is not infrequently demonstrated to the lady of the house, if she happens to be in; if she takes a fancy to it, it is left for awhile with a midget meter to indicate its consumption.

My "live man" has got to get new connections. He has a showroom somewhere. If possible, it goes from front to back of a block, and a short cut through it is thrown open to the public, and well advertised. It is quite conceivable that electrically-cooked food can be bought and eaten there; at any rate, every wiring contractor of standing in the neighbourhood has agreed on a common standard of charges, and these are in plain sight of the public. Very likely there is a gas service laid on (I don't think they can refuse it), and all sorts of delicate fabrics and papers are continually exposed to the fumes; similar pieces are in similar positions to arc, glow and flame lamps. The public gets a whiff of gas as it passes this part of the show.

He has discovered a few ardent young students of electricity in the town, and in return for the help he can give them by letting them play with his apparatus, they give, by way of practical preparation for their future professorial chairs, short public lectures and demonstrations. I can imagine that he has a thing like a vacuum cleaner, a portable generating set; and that every gas user in the town has been invited to see his drawing room and dining room, or shop window electrically lighted for once. One-watt lamps are used in handsome fittings, and he is told the cost on the spot. The whole business is tastefully done; the man or men in charge are neat and clean, their boots included. The gas-user has it all explained to him, and spends an amusing and exciting half hour or more. The more depends on the strength of the nibble he appears to give.

If the central stations of the country exhibited on the average half the energy in pushing their wares that certain shining examples are exhibiting, the talk of depression would cease in six months. The cost of metallic filament lamps will soon, let us hope, be reduced by competition, and then the "tide in the affairs" of electric lighting will, indeed, be at its flood. A gas burner will not require to be lit by a match with a loud pop and concomitant destruction of the mantle, to the end of time; nor will the gas fire necessarily remain an eyesore, and have matches thrown at it half across the room by nervous ladies wishing to light it. CO_2 and water are not destructive to human life, wall paper or furniture; and it is conceivable that the gas of the future may burn to these harmless products and nothing else. "Science Abstracts" (Engineering) might do well to include a section, "Advertising."

BUSINESS NOTES.

E.C.C. Employés' Hospital Contributions.—During the past year the employés of the Electric Construction Co., Ltd., Wolverhampton, have contributed £143 3s. 9d. to the Hospital Saturday Fund.

Meter Approved.—The *London Gazette* for December 6th contains notice of the Board of Trade's approval of the British Thomson-Houston Co.'s induction wattmeter type A.C.T. deposited on July 2nd, 1906.

Electrical Progress in Spain.—The Commercial Attaché to H.M. Embassy at Madrid (Mr. S. P. Cockerell) reports that, according to the Government returns, there were in Spain in 1901 only 861 electric power stations, of which 651 were restricted to public lighting, and 210 to private lighting. Since then the number of power stations for electric lighting has increased considerably, and the use of electricity has become more general in transmission and distribution of energy, electro-chemical industries, smelting furnaces, &c., but there is still a vast field for further industrial developments, as the supply of power which the country affords is far from being exhausted. Indeed, while some regions of Spain appear to be almost over-developed, there are others which are completely abandoned. This is due to the fact that Spanish capitalists are distrustful as to all new business and therefore very unwilling to invest their capital in such undertakings. Then again, they are not used to the formation of companies in partnership, which circumstance entails the consequence that large industrial enterprises are allowed to pass by. They find generally that it is more convenient and less troublesome to invest in Government securities which yield a fair interest without more trouble than cutting their "coupons." Foreign capitalists, however, have discovered that electricity could be applied in Spain to great advantage. Belgian, German and French financiers have taken this view, and they are found to be interested in nearly all the larger electrical concerns in Spain, whilst British capital is very scarce for such undertakings. Spain is a country whose production is far below its consumption, and as cheap motive power can be obtained, numerous industries could be established which would prove to be good investments. Most Spanish towns of any importance, Mr. Cockerell says, have a fair service of public and private electric lighting, but business in this direction is not by a long way yet exhausted, as many of the existing installations are deficient and could easily be reformed, or competition could easily be effected under favourable conditions, thanks to the improvements which the construction of electrical machinery and material have undergone during late years. And, furthermore, there are a considerable number of towns, some of them of importance, which are not yet supplied with electric lighting. Leaving on one side the question of competition, there is, as stated above, still much to be done by way of electric lighting for smaller towns and villages, and, in Mr. Cockerell's opinion, an investment in such undertakings would yield fair profits without going to great expense. There are in Spain in its various provinces over 400 towns and villages of over 4,000 inhabitants where there are no electric power stations. British capitalists should, says Mr. Cockerell, study carefully the advisability of installing electric light plants in the larger towns and even in the smaller ones, and quick action in the matter would, in his opinion, fully compensate such an undertaking. As regards the towns and villages which are not yet lit by electricity, Mr. Cockerell states that the north-west region of Spain (Galicia) is almost devoid of electricity. Galicia is formed of the provinces of Corunna, Lugo, Orense and Pontevedra. They are very rich in minerals, mineral waters and cattle; the country is very fertile, and has the advantage of being near the seaboard, with many good ports which have a regular traffic with the United Kingdom and South America (Vigo, Villagarcia,

Corunna, &c.). Yet these natural advantages and resources have been ignored up to the present, owing to the absence of railway communications, which has resulted in the alarming emigration from that region, greatly outnumbering that from any other region of Spain. "This," adds Mr. Cockerell, "is especially regrettable, occurring as it does in a region of a wealth perhaps second to none in the kingdom, whose inhabitants are notoriously industrious and of more solid intelligence than the southern Spaniard. A careful investigation into the conditions of the country would reveal many promising fields to the advantage of investors and industrials, and the country."—*Board of Trade Journal.*

Trade Announcements.—We are informed that Mr. John Sydenham has commenced business at Penarth as a consulting engineer and expert in electric lighting.

At the end of the current year Messrs. E.A.G. v. Kolben & Co. are closing their London office at 20, Budge Row, Cannon Street, E.C. Until further notice all communications and inquiries should be sent direct to the head office at Prague, Austria.

Messrs. Putz Curphey & Co., of 19 and 20, Strand Street, Liverpool, have opened an electrical supplies department, and they desire catalogues of all classes of electrical goods.

Mr. Edward Barnard, electrical engineer, 28, Bird Street, Lichfield, has been joined in partnership by Mr. A. T. Levet, and the business will be carried on in future under the style of Barnard and Levet.

Book Notices.—"Hazell's Annual, 1908." By W. Palmer. London: Hazell, Watson & Viney. 1908. Price 3s. 6d. net.

"Etat Actuel de la Science Electrique." By Prof. Devaux-Charbonel. Paris: Dunod et Pinat. 1908. Price 20 fr.

"La Technique de la Houille Blanche." By E. Pacoret. Paris: Dunod et Pinat. 1908. Price 25 fr.

"Superheat, Superheating and their Control." By W. H. Booth. London: A. Constable & Co., Ltd. 1907. Price 6s. net.

"Technical Thermo-Dynamics." Two Vols. By G. Zeuner. Translated by J. F. Klein. London: A. Constable & Co., Ltd. 1907. Price 36s. net.

"Technical Index." December, 1907. Vol. XI. No. 3. London and Brussels: M. J. Fitzpatrick. Price 1s.

"British Railway Finance." By J. Russell Sowray. London: E. Stanford. 1907. Price 1s.

"Lord Wantage, V.C., K.C.B.: a Memoir by his Wife." London: Smith, Elder & Co. 1907. Price 10s. 6d. net.

"The *Mechanical World* Electrical Pocket-Book, 1908." Manchester: Emmott & Co., Ltd. 1907. Price 6d. net.

Bankruptcy Proceedings.—R. S. Blackburn, electrical engineer and contractor, Hebden Bridge.—A first dividend of 2s. 6d. in the £ is payable on December 20th at the offices of the Official Receiver, 14, Chapel Street, Preston.

Catalogues and Lists.—National Electric Lamp Association, Cleveland, U.S.A.—A number of illustrated bulletins giving full information concerning the following lamps:—No. 5A, tantalum regular and tantalum meridian lamps and units; No. 6A, tungsten street series lamp; No. 7 containing a good deal of data on illumination compiled by the Association's engineering department for the use of architects, building contractors, illuminating and electrical engineers, &c.

Messrs. Siemens Bros. & Co., Ltd., York Mansion, Westminster, S.W.—Priced and illustrated circular relating to the Siemens electro-dynamometers.

Worthington Pump Co., Ltd., 153, Queen Victoria Street, London, E.C.—A new and finely-produced catalogue (D.E. 30) of 140 pages, abounding in excellently-printed half-tone illustrations well printed on high-class paper, very fully covering the Worthington triplex power pumps. Particulars concerning their construction and operation are first given; later, vertical single-acting and double-acting types for various pressures are well set out, and ten pages follow giving brief illustrated particulars of a number of electrically-driven types. Other material in the book relates to triplex power pumps with automatic by-pass arrangement, horizontal duplex power pumps, vertical triplex power well-head, vertical duplex electric sinking pump, and horizontal triplex packed plunger pumps.

Mr. Frederic Nell, 46, Queen Victoria Street, London, E.C.—Catalogue No. 66 just issued, giving in the course of 48 pages brief descriptions, many illustrations, and a good deal of tabulated information relating to his duplex steam pumps, triplex power pumps, condensers, compressors, and the "Victor" turbine water wheels, of which some thousands are in service in different parts of the world. A number of views of these turbines of types suitable for medium falls are shown. Some loose leaflets describe the heavy duty turbine cleaner, the pneumatic tube cleaner, and the twin strainer for water supply, all manufactured by the Liberty Manufacturing Co., of Pittsburg, U.S.A.

Messrs. Gibbons Bros., Ltd., engineers, &c., Dibdale Works, Dudley, Worcester.—Desk blotting pad with useful calendar for 1908 at the left-hand side. Among the firm's special manufactures which this pad will keep before the user's mind are firebricks, boiler seating blocks, coal bunkers and gas retorts.

American Conduit Co., New York, &c.—A number of leaflets and a pamphlet relating to their system of bituminised fibre conduits for underground conduit construction.

Messrs. Veritys, Ltd., 31, King Street, Covent Garden, W.C.—A card that will raise a smile, and at the same time remind one of the "Aston" electric radiators, before one of which on the hearth-rug a canine pet lies deeply sleeping quite overcome with the healthy warmth, thus giving the company one more "unsolicited testimonial" to the satisfaction which consumers get from the luminous radiator.

The General Electric Co., Ltd., 71, Queen Victoria Street, London, E.C.—16 pp. booklet describing their Coates's Magneto Ignition System and some other specialities in motor accessories. The introduction of the Coates system was necessitated by the fact that since magneto ignition proved preferable to battery ignition and high-tension ignition preferable to low tension, it was found advisable to develop a system which would allow the company to build the magneto itself as a low-tension one, separating the high-tension apparatus entirely from it, and thus producing a thoroughly safe and reliable apparatus. Of course the company's experience in mechanical and electrical dynamo design was of great value in enabling them to ensure the absolute reliability of such apparatus. The catalogue contains, in addition to the above, the special "Geeko" sparking plugs, dashboard switches, and other accessories, which they have developed in connection with the motor-car accessories department of their business. The pamphlet is illustrated with a number of small half-tone views of the apparatus, also some line diagrams.

Messrs. E. R. and F. Turner, Ltd., Ipswich.—Postal card making a brief general statement concerning Suckling's water-tube boiler.

Sturtevant Engineering Co., Ltd., Queen Victoria Street, E.C.—Circular showing the latest editions of their various sectional catalogues. These cover practically the whole field of the company's specialities, including mechanical draught for boilers, heating and ventilation, feed-water heaters, and many manufactures for special engineering lines.

For Sale.—In our advertisement pages will be found information relating to a sale of machinery and engineers' and ironfounders' accessories that is to be conducted by Mr. Arthur Ayres at the Kennet Ironworks, Reading, on December 19th and 20th.

Canadian External Trade.—A Canadian correspondent of the *Times* states that in the near future the Dominion Government will probably appoint a commissioner to stimulate the use of Canadian products throughout the West Indies, where, hitherto, the matter has been attended to only by agents in some of the islands. The appointment of a commissioner for New Zealand is also foreshadowed, the Canadian trade representative at Sydney being too far away to exert a very effective influence on the new Dominion.

LIGHTING and POWER NOTES.

Argentine.—It is reported that the electric light and power station, and electric tramway concession granted by the Tucuman Municipality to Mr. B. S. Garcia, will be taken over on completion by the German Transatlantic Co.

Beckenham.—Quite recently the U.D.C. employed a prominent firm of experts to examine and report as to its electricity station. This report came out some time ago, and in consequence recommendations have been passed for applying for a further loan to make certain extensions. At this week's meeting of the Council a letter was read from the chairman of the Committee of the Beckenham Ratepayers' Association, who passed some severe criticisms on the undertaking, asking for a copy of this report. A motion to send the letter to the Electricity Committee, which consists of the whole Council, was passed, after amendments to let the Association have a copy and to send copies to the Press, were defeated.

Burnley.—The electrical engineer has been instructed to prepare a report on the advisability of providing additional plant at the electricity works.

Buxton.—A L.G.B. inquiry was held on December 4th into the application of the U.D.C. for loans of £1,800 for E.L. purposes, and £3,000 for the provision of a refuse destructor. There was no opposition.

Canada.—Toronto.—The civic authorities are considering two complicated problems relating to lighting and power. Some time ago the city fell into line with the proposal of the Union of Western Ontario Municipalities, organised to promote a cheap power scheme in connection with Niagara Falls, according to which Toronto would provide an amount of £500,000 and obtain control of an electrical supply jointly with other cities. An alternative scheme is now under consideration by which the city would find £200,000 new capital for the Toronto Electric Light Co., whose directors on November 22nd proposed "as a possible solution of present difficulties" an agreement whereby the company would issue $1,000,000 of capital stock at par to the city, to be paid up within the next few years, the city to have a representation on the board; also a sale to the city of the plant and assets of the company at a price based upon its present earning power. The company affirm that this proposition amounts to a partial public ownership, and gives to the city the advantage of an established and successful business, not only self-supporting, but also profitable from the start.

China.—The Hankau Waterworks and Electric Lighting Co. has placed an order with Messrs. Johnson & Phillips for the supply and erection of a generating station of 1,500 KW. capacity, and for the mains and supplies. The amount of the contracts is approximately £50,000, and the project is remarkable for the fact that it is the first case in which the Chinese have themselves formulated such a scheme and provided the requisite capital for it. Hankau has a population of 350,000.—*Commercial Intelligence.*

Continental Notes.—AUSTRIA.—The Government has, according to *l'Elettricita*, accorded to Rhomberg and Ruesch, of Dornbirn, the concession for utilising the water-power obtainable from Lake Millstaetter. It is proposed to erect three separate generating stations. One of these will be in the valley of the Drau River, where a fall of 85 m. is to be obtained; two other falls of 17 and 100 m. respectively on the Liesser will be the sites for the other stations. The first station will contain 12 generating sets of 5,000 H.P. each, two of which are to be used as a stand-by. The small station will be equipped with three sets of 2,000 H.P. each, and is to serve principally in the case of drought. The third station will be equipped with plant to give an additional 18,000 H.P. Contracts have been entered into between the Government and the power producers for the supply of energy to work the railways between the Voralberg district and Switzerland.

ITALY.—A company has lately been formed in Rome, with a capital of £800,000 and the title La Syndicate per la Trazione ed Illuminazione Elettrica, in Puglie, to establish electric lighting plants and tramways in the Puglia district in Italy. It is stated that a commencement is to be made with the establishment of a central power station of a capacity of 2,400 H.P. at Trani.

Durham.—It is stated that the Tribley Pitt, Pelton Fell, is the only one in England exclusively operated by electricity. An electric winder, with a capacity of 800 tons in seven hours, was tested recently, and among other things, haulage, ventilating and pumping are electrically operated.

Glasgow.—Owing to the excessive coal bill for the past year, it has been decided by the directors of the Glenboig Union Fireclay Co. to introduce electric driving at its works. Careful calculations have shown that the saving each year by substituting electric power for steam power will amount to £3,000. This is a very reasonable estimate, for the coal bill for the past twelvemonth was £6,000 higher than usual, so that even allowing for a reduction on the high prices of coal hitherto ruling, the electric power will effect a saving of about £60 per week. The cost of the electrification will probably amount to £12,000.

Hereford.—The E.L. Committee has recommended an application to the L.G.B. for powers to borrow £1,500 for cables and services.

Johnstone, N.B.—The question of lighting the town by electricity, supplied by the Strathclyde Electricity Co., has been before the Council, and the board has agreed to have a conference with the company on the question.

London.—ISLINGTON.—The Lighting Committee has decided to substitute Excello Flame arcs on certain roads in the Highbury district at present lighted by Crompton's double-carbon arcs. Messrs. Crompton have agreed to take back their lamps on condition that they are paid £150 for hire.

Macclesfield.—The T.C. on December 4th decided to consent to Messrs. Vaudrey, Oppenheim and Mellor applying for powers to transfer the E.L. Order from the Macclesfield and District Tramways Co. to a new company, on the new concern undertaking to pay to the Corporation £650.

Market Harborough.—The U.D.C. has applied to the B. of T. to defer the revocation of the E.L. order for five years.

Pontypridd.—A L.G.B. inquiry was held on November 6th into the application of the U.D.C. for a loan of £3,600 for electricity purposes. There was no opposition.

Redditch.—The U.D.C. has applied to the L.G.B. for a loan of £500 for E.L. purposes.

Tunbridge Wells.—The T.C. has decided to convert 200 gas standards into electric lamps, at an annual charge of £3 9s. 4d. per lamp.

The L.G.B. has forwarded to the Council sanction to loans of £1,940 for excess expenditure, £6,658 for new plant, and £946 for public lighting. A sum of £40, the cost of 200 Osram lamps, has not been sanctioned, the Board deciding that such expenditure should not be defrayed out of borrowed money.

Walmer.—In extending the E.L. Order for a year from November 20th, the B. of T. has informed the U.D.C. that if, at the end of that period, there is no evidence of the Order being put in force, it will be revoked without further notice. The Board has also informed the Council that the Order contains no provision enabling the Council to transfer its powers to a company.

Wednesbury.—The L.G.B. will defer dealing with the application of the T.C. for sanction to borrow further moneys for the electricity undertaking, including the construction and equipment of a generating station, until the Council has considered a B. of T. suggestion as to obtaining the revocation of the order of the Midland Electric Corporation for Power Distribution, Ltd., of 1898, in so far as it relates to Wednesbury. It has been decided, therefore, to make application for this revocation.

Wigan.—Two statements relating to the working of the Wigan and Pemberton Works have been placed before the T.C. From these it appears that from April 1st to September 30th the Wigan working and financial charges amounted to £9,678, and receipts to £9,433, showing a loss of £245. For the Pemberton works the figures were £3,642, £2,325, and £1,317 respectively.

TRAMWAY and RAILWAY NOTES.

Bournemouth.—The band of H.I.M. Yacht *Hohenzollern* played at the winter gardens and at Christchurch Priory on Thursday and Friday last week, and the transit between these places was accomplished in the Corporation saloon and another car decorated for the occasion.

Clayton-le-Moors.—The U.D.C. last week-end assented to a notice from the Blackburn, Whalley and Padiham Light Railways Co. which announced its intention to make application to the Light Railway Commissioners for an order to revive and continue its powers and to extend the time limited by the Blackburn, Whalley and Padiham Light Railways Order, 1901.

Continental Notes.—POLAND.—La Société des Charbonnages Comte Renard, which is completing the establishment of a large electric power station in connection with its collieries, has applied for a concession to construct and work an electric tramway between Sosnowice and Dombrowo.

GERMANY.—Work is about to be commenced on the construction of an electric tramway between Horst and Osterfeld.

BELGIUM.—The Provincial Council of West Flanders has resolved on the establishment of a system of electric light railways in the Bruges district at an estimated cost of £88,000.

Gorton.—The Council has decided to make application to the L.G.B. for sanction to borrow £11,349, the expenditure in respect of the new electric tramways in Gorton Lane, Wellington Street, and Reddish Lane, connecting Stockport with Reddish, Gorton, Openshaw, and Cheetham Hill.

Isle of Man.—An Accrington man has formulated a scheme for a submarine tube railway between Blackpool, Southport and the Isle of Man. It is stated that the scheme has been considered by the Furness Railway Co.

Japan.—Mr. K. Katayama, chief engineer for the Government Railways of Japan, is on his way home from his mission to Europe and America, where he has been looking into the latest developments of electricity with a view to the introduction of electric power in the operation of the railroads of Japan. Japan is excellently provided by nature with mountain streams and rivers, at which electric power can be produced under economic conditions. The idea is to operate all the Government railroads of Japan, which now constitute nearly the whole of the mileage, with electricity. Ultimately, perhaps, the whole of the 25,000 miles of railroads now in operation in Japan will be worked by electric power.

Leeds.—A special meeting of the T.C. was held on the 4th inst., to determine upon the expediency of promoting a Bill in the next session of Parliament to authorise the Corporation (*inter alia*) to construct tramways in the urban districts of Horsforth, Rawdon, Yeadon, and Guiseley. The Rawdon, Yeadon, and Guiseley U.D.C.'s having agreed to pay to the Corporation £400 per annum for a period of 11 years from the date of the opening for public traffic of the tramway, the scheme was carried unanimously. A motion to rescind the resolution at the annual meeting appointing an 'Electricity Committee, and to delegate its powers and duties to the Tramways Committee, which should be styled the "Tramways and Electricity Committee," was introduced. Subsequently, an amendment, which differed mainly from the motion in that it called upon the newly constituted Tramways and Electricity Committee, to report to the Council not later than the February meeting of the Council as to the manner in which the powers and duties to be delegated were to be exercised and carried into effect, was moved. In defence of the Electricity Commitee, it was pointed out that the latter had been thrust on one side, without a word of explanation, and it was intended to transfer the department which had been under their care to the Tramways Committee, who would look at everything through tramway spectacles. After further discussion, however, the amendment was carried, and the Committee was elected.

London.—It is stated that the suggested uniform 2½d. through ticket, available on all tube railways, has been abandoned in favour of books of tickets entitling the passenger to travel between certain groups of stations.

HACKNEY.—The General Purposes Committee of the B.C. has had under consideration the proposed electrification of the portion of the Lea Bridge Road tramways in the County of London, worked by Leyton U.D.C., and approves of the adoption of the overhead trolley system. Loans to the extent of £33,815 are required for electricity purposes (public lighting and mains), and it is proposed that tenders be invited for a loan of the whole or part of the amount required, repayable on the instalment or on the annuity system.

L.C.C.—At the meeting on Tuesday, the Highways Committee referred to the completion of the reconstruction of the Holloway Road tramways, and mentioned that full services of electric cars would shortly be put in operation on that route. If the horse-car services on the Seven Sisters Road and Caledonian Road from Finsbury Park and the Archway Tavern were interposed between the electric cars on the Holloway Road and Upper Street lines, the financial results would be seriously affected, and it was, therefore, proposed to bring forward a recommendation for the reconstruction of the tramways in Seven Sisters Road and Caledonian Road at an early date.

The Highways Committee reminded the Council of the acceptance last July of the offer of the G.B. Surface Contact Co. to supply and fix for the sum of £3,360 surface-contact equipments for 48 of the cars to be used on the Aldgate to Bow tramways. The company had declined to enter into a contract in the form desired by the Council, and the Committee had been in communication with the company with a view to arriving at a settlement. A form of contract had now been agreed upon, which provided that the fixing of the equipments on the cars should be done by the tramways department under the supervision of the company. The arrangement would involve additional expenditure of about £250, would enable the Council to have a contract more in accordance with the views of the Committee, and would materially expedite the completion of the work.

The Council was asked to sanction certain expenditure in excess of the annual maintenance votes for 1906-7. Among the items was a sum of £12,516 as additional outlay on repairs of the southern tramways. The expenditure on permanent way repairs alone exceeded the estimates by £10,000 (included in the sum mentioned), in consequence of the cost of necessary anchoring of rails, new curves and extra paving works, whilst the remainder was due to delay in converting certain lines. An excess of £4,508 was also caused by delay in the opening of the Greenwich power station and the procuring of power for the Embankment tramways, when started, from a temporary source.

The Woolwich B.C. is prepared to supply the L.C.C. with an additional 100 kw. of power for the proposed tramways from Abbey Wood to Wickham Lane, conditional upon the whole supply being taken for a period of three years.

The work of boring and the iron structure of the tunnel connecting the Embankment and the Kingsway tramways are now completed. The tunnel goes under Somerset House, past the *Morning Post* offices, and then to the present terminus of the Aldwych section. The work is expected to be completed by the end of March or the beginning of April.

Misterton-South Petherton.—A local syndicate has applied to the Light Railway Commissioner for an order authorising the construction of a light railway between Misterton and South Petherton, *viâ* Crewkerne, West Crewkerne, Haselbury, Plucknett and Merriott.

New Zealand.—Great opposition has been raised amongst the various tramway authorities to a Tramways Amendment Bill, which is being introduced by the Government. Amongst other things, inspection of drivers and of plant and equipment are provided for; also regulations as to passengers and traffic working come within the scope of the Bill.

Richmond.—The T.C. on Tuesday night passed a resolution asking the London United Electric Tramways Co. to promote a Bill next session to construct tramways across Kew Bridge. It is proposed in connection with the foregoing that the horse tramway in Kew Road shall be electrified.

Wigan.—A statement has been issued showing that from April 1st to October 31st the total tramway receipts amounted to £39,860, as compared with £37,913 in 1906. As the expenditure during this period only exceeded receipts by £622, as compared with some £8,994 last year, it is hoped that the tramways department may make ends meet in the current year.

TELEGRAPH and TELEPHONE NOTES.

Communication with the West Indies.—The West India Trade Section of the Liverpool Chamber of Commerce recently resolved to urge the companies administering the telegraph cables to the West Indies and British Guiana to provide more stable communication at reduced rates for the transmission of messages to and from the United Kingdom, as the frequent breakages in the cables and the present high charges retard the development of trade with the places named, and impose inconvenience and cost upon the sender.

Nigeria.—The Committee of the Liverpool Chamber of Commerce has decided to ask the Colonial Office to establish wireless telegraphy in Southern Nigeria, as the present landlines are unsatisfactory, and are the cause of much delay to telegrams between the United Kingdom and Lagos and Torcados.

Havana Cable.—The length of the New York-Havana cable belonging to the Commercial Cable Co. is 1,285·5 nautical miles. The cable has one conductor.

Telegraphic Interruptions and Repairs:—

	Cables.	Interrupted.	Repaired.
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo	Closed..	Jan. 12, 1906 ..	..
Tarifa-Tangier		Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)		Mar. 9, 1904 ..	..
Garachico-Santa Cruz		July 12, 1906 ..	..
Brest-Dakar		July 22, 1907 ..	..
Cueta-Tangier		Dec. 7, 1907 ..	..
Falmouth-Bilbao		Dec. 9, 1907 ..	..
	Landlines.		
Puerto-Barrios		Aug. 2, 1902 ..	..

CONTRACTORS' COLUMN.

Openings for New Business.

ACTON.—Additions (accommodating 176) to the Central Council School, Shakespeare Road. E. C. P. and H. Monson, architects, 182, High Street, Acton, W.

ALNWICK.—New Presbyterian Church at Broomhill. George Reavell, jun., architect, Bondgate, Alnwick.

ASTLEY (Lancs.).—Thirty new houses. Mr. Cross, Astley Peel Hall, Astley, near Manchester.

BARNSLEY.—New hotel, stables, &c., at Ashby. Tennant & Collins, architects, 10, Regent Street, Barnsley.

BATLEY (Yorks).—Enlargement to clothing factory for Anty's, Ltd. Also extensions to the Co-operative Mill.

BIGGLESWADE.—New church schools (£2,500). Rev. R. W. Barber, vicar of Biggleswade.

BIRKDALE.—Twelve houses in Dunkirk Road for Mr. T. Tasker.

BIRMINGHAM.—Extensive additions to the Great Western Hotel. H. Lovatt, Ltd., builders, Darlington Street, Wolverhampton.

(Bearwood).—New vicarage for the parish of St. Mary's. E. P. Green, 32, Sandon Road, Edgbaston, Birmingham.

BLACKPOOL.—Houses and shops in Central Drive for A. Atherton.

New Wesleyan Sunday Schools at North Shore. Geo. Paton, architect, Birmingham; Skerfoot & Son, builders, Whitegate Drive, Blackpool.

BOLTON.—New electric motor-house for the T.C. W. Burrows & Son, builders, Ruth Street, Bolton.

BOURNEMOUTH.—New hospital in Lowther Road for the Committee of the Victoria Hospital.

New Municipal offices, law courts, and police station for the T.C. (£27,000 to £36,000). H. N. Hawks, architect.

BRIXHAM (Devon).—Additions to the Congregational Church. W. G. Coulcery, architect, Paignton.

BURHAM (Surrey).—School. Jarvis & Richards, 36, Victoria Street, S.W., architects.

BURY.—Banking premises, Fleet Street, for the Yorkshire Bank, Ltd.

New club premises for the Blackford Bridge Conservative Club.

CANTERBURY.—Residence, New Dover Road, for F. R. Biggleston.

CAREG-Y-PLAS (North Wales).—Proposed starting of a new jasper quarry by a new syndicate.

CARLTON (S.E.).—Congregational Church and hall on Eastcombe Estate (£6,000). Rev. S. Lloyd-Davies, pastor.

CHESTER (Ellesmere Port).—Forty houses for the Wolverhampton Corrugated Iron Co.

CHISLEHURST.—Electricity sub-station (£3,000) for the Chislehurst E.L. Co.

COCKFIELD (Co. Durham).—New Temperance Institute. J. Howe, architect, Cockfield, Co. Durham.

COLCHESTER.—Pavilion in Castle Park. Mr. H. Goodyear, borough engineer, Town Hall, Colchester.

CREDITON.—Secondary school for girls for Devon C.C.

DARWEN.—New warehouse to be built. Messrs. Harwood Bros., cotton manufacturers.

DURHAM.—New training college for teachers. J. A. L. Robson, secretary for higher education, Shire Hall, Durham.

EAST DEREHAM (Norfolk).—Improvements and enlargements at Brisley Church of England Schools. Rev. W. H. Lowe, Brisley Rectory, East Dereham.

ELLAND (Yorks.).—New mill. S. Jackson & Son, architects, 11, Tanfield Chambers, Bradford, Yorks.

Proposed secondary school for Elland, Greetland and Stainland.

ELTHAM.—Eight houses. A. C. Corbett, 121, Earlshall Road, Eltham.

ENFIELD.—Congregational church and Sunday schools in Armfield Road, Lancaster Road. Rev. Dr. J. G. James.

FLINT.—New Council School for the C.C. Mr. Evans, architect, County Buildings, Mold.

FOLKESTONE.—Detached residence for T. E. Moody. F. Newman, architect, 4, Bouverie Square, Folkestone.

Detached residence, Dover Road, for the S.E. and C. Railway Co. C. E. Mercer, architect; W. Dunk, builder, Fontine Street, Folkestone.

GILLINGHAM (Kent).—New church. "St. Luke's."

GLOSSOP.—New public elementary school at Hadfield for the T.C. Ogden and Hoy, architects, Examiner Buildings, Strutt Street, Manchester.

GLOUCESTER.—Residence, stables, &c., near Mitcheldean Road Station, for Francis Wintle. Chatters & Smithson, architects, 17, Regent Street, Cheltenham.

GREAT HARWOOD (near Blackburn).—Proposed big weaving mill.

HANLEY.—Important extension of business premises for J. H. Ball & Sons, Trinity Street. T. Godwin, builder, Raymond Street, Hanley.

HULL.—Business premises on the public hall site for the T.C. G. H. Panton, builder, 202, Anlaby Road, Hull.

Two Wesleyan mission halls (£25,000).

JOHNSTONE (Renfrewshire).—New baths, &c. Kerr & Watson, architects, Johnstone.

LEIGH (Lancs.).—New Grand Theatre to seat 2,000. Prescot & Bold, architects, Wigan.

New spinning mill (£70,000). J. W. Cowburn, builder, Leigh.

LEIGH-ON-SEA.—Bungalow. A. Cole, architect, 34, Thurlestone Road, West Norwood, S.E.

LICHFIELD.—New childrens' homes at Wissage for Lichfield Union. R. J. Barnes, architect, City Chambers, Lichfield.

LINDOW (Lancs.).—New Parish Hall (£1,000).

LONDON, E.C.—Extensive alterations to 109, Queen Victoria Street. Jones, Lang & Co., 3, King Street, Cheapside, agents.
(Forest Gate).—Additions and alterations to steam laundry. G. J. Hosking, 27, Sylvan Road, E., builder.
(Hampstead, N.W.).—House in Darby Avenue. Sabey & Son, Ltd., St. Peter Street, Islington, builders.
(South Kensington).—House in Campden Hill Square. Rogers, Bone & Coles, 7, Carteret Street, S.W., architects.
(Streatham).—Building in High Road. E. B. l'Anson, 7A, Laurence Pountney Hill, E.C., architect.
(Watford).—House (£980). G. Rickett, 195, Harwood Road, Watford, architect.
(Finchley Road).—Buildings for R. Hovenden & Son, Ltd., 29-33, Berners Street, W.
(Fleet Street).—Shop and offices on site of No. 59. Braid, Pater and Co., 9, Bow Churchyard, Cheapside, E.C., builders.
(Piccadilly).—Extensive alterations to No. 110. Rice & Sons, Stockwell Road, S.W., builders.
(Streatham).—Ten houses. Holliday & Stranger, 227, High Road, Streatham, agents.
(City).—Building in Knightrider Street. G. D. Martin, 3, Pall Mall East, architect.
(Paddington, North).—Blocks of working class dwellings off Harrow Road. Joseph & Smithem, 83, Queen Street, E.C., architects.
(Hornsey, N.).—Moravian Church in Priory Road (£5,000). W. Church & Son, 12, South Place, Finsbury, architects.
(Woolwich).—Sunday School. G. Bishop, 23, Heavitree Road, Plumstead, S.E.
(Woolwich).—Alterations and additions to Duke of York public house. J. O. Cook, 2, Wrottesley Road, Plumstead, S.E., architect.
(Whitehall, S.W.).—New offices for the Board of Trade and proposed Military Recruiting Department.
(Hounslow).—Schools (£10,500). A. Lancelot Lang, Council House, Hounslow, architect; W. Lacey, Hounslow, builder.
(Finchley Road, N.W.).—Two houses. R. Vernon Hart, Burgess Hill, agent.

MANCHESTER.—New public baths at Withington.
MERTHYR TYDFIL.—Extensions to Parish Council School. J. Ll. Smith, architect, Central Chambers, Merthyr Tydfil.
MONTROSE.—Double villas in Doward Place. D. Brown, builder, Montrose.
NEWCASTLE-UNDER-LYME.—Extensive additions and alterations to Middle Boys' School. A. R. Wood & Son, architects, Tunstall and Burslem.
NORTH SHIELDS.—New stores and offices on Union Quay for Tynemouth T.C. J. F. Smillie, borough surveyor.
OLDHAM.—Proposed new mill on the old Longrange Mill site at Waterhead.
PLYMOUTH.—Additions and alterations to Brixton Schools. King & Lister, architects, 8, Princess Square, Plymouth.
PONTYPRIDD.—New cottage hospital (£3,000). H. M. Gregory, secretary.
PORT GLASGOW.—New school at Highholm (£15,000).
PRESTON.—New place of worship. Contractors, R. Rathbone & Sons, Atherton.
RADCLIFFE (Lancashire).—Proposed new Council offices, &c. S. Mills, clerk to the Council, Council Offices, Radcliffe.
RISHTON (Lancaster).—Proposed new spinning mill.
ROCHDALE (Milnrow).—New cotton mill for the Butterworth Hall Spinning Co., Ltd. L. Hall, director, Oldham.
ROMILEY (near Stockport).—Important extensions, including new weaving shed to Elder Mill, for the Elder Mill Co.
ST. ANNES-ON-SEA (Lancs.).—Semi-detached villas in Knowles Road, for E. England.
SEATON DELAVAN.—New Methodist Free Church at Avenue Head (£1,000).
SHEFFIELD.—Travellers' Rest Hotel, Sheffield Moor, to be rebuilt. Hall and Fenton, architects, 14, St. James' Row, Sheffield.
New Dual Secondary School at Woodhouse for the West Riding of Yorks C.C. Jas. E. Knight, architects, 33, College Street, Rotherham.
SHEVINGTON (near Wigan).—Proposed new weaving shed. J. Lyon, Shevington Weaving Co., near Wigan.
SKEGNESS.—New Bungalow Home for the Nottingham Poor Girls' Camp Society.
SOUTHALL.—New St. George's Church on Hambrough Estate.
STAFFORD.—New colour works in Burley Terrace for K. Benham.
SWANSEA.—Municipal housing scheme (99 houses, £23,100). M. Hoskins, architect, Swansea.
SWINDON.—Business premises, Victoria Road, for J. Groves & Sons, Ltd.
TORQUAY.—Business premises in the Strand, to be rebuilt for R. T. Knight.
New Pavilion in Princess Gardens (£7,500), for a local syndicate. H. Williams, Mount Neesing, Torquay.
WARE (Herts.).—Important additions to the works of Allen & Hanbury, Ltd.
WEST BROMWICH.—New schools at Hill Top for the T.C. (£12,000).
WHITBY.—Additions and alterations to the Conservative Club, Marine Parade, for J. H. Harrowing. Geo. S. French, architect, Bank Chambers, Whitby.
WIDNES (Lancs.).—New Anglican Church (£24,000). Contractors, R. Rathbone and Sons, Atherton, near Manchester.
WIGAN.—Proposed public abattoir. Town Clerk, Wigan.
New vicarage for St. Michael's parish.
WINSFORD.—New higher elementary school for Cheshire C.C. at Over.
WOLVERHAMPTON.—New works for Chubb & Son's Lock and Safe Co., Ltd.

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—December 28th. A double line of electric tramway, permanent way, electric masts, cables, wiring, lamps, &c., for the Belfast Harbour Commissioners. See "Official Notices" November 22nd.

Belgium.—December 17th. The municipal authorities of Flemalle Haute (Liége) are inviting tenders for the establishment of a central generating station in the town for the supply of electrical energy for public and private lighting and power purposes. Tenders are to be sent to La Maison Communale de Flemalle Haute (Liége), whence particulars may be obtained.

Brussels.—December 18th. A public adjudication will take place at the Bourse on December 18th in regard to 74 lots of telegraph and telephone material. Specifications, No. 203, may be obtained at the Administration des Postes et Telegraphes, Place de la Mounaie.

Brussels.—December 31st. The Commandant du Génie requires tenders for the electric lighting of the Military School. Specifications, 1s. 8d., from 40, Rue de Reutiers. A deposit of £240 is required.

Buenos Ayres.—It is stated in the *Review of the River Plate* that the municipality has been calling for tenders for the construction of an asylum for beggars and incurables, to be fitted with electric lifts and electric lighting.

France.—January 15th. The municipal authorities of Lyons are inviting projects for the establishment of a combination refuse destructor and electric power generating station.

Manila.—January 15th, 1908. Sewage pumps to be worked by electric motors are required by the municipal authorities.

Tyrol.—The municipal authorities of Partschins (Tyrol), are about to invite tenders for the establishment of a central generating station in the town for the supply of electrical energy for lighting and power purposes.

Warrington.—December 17th. Motors for one year for the electricity department. See "Official Notices" December 6th.

CLOSED.

Auckland (N.Z.).—The City Council received the following tenders for installation of electrical plant, wiring, &c., at the Abattoir works:—

Turnbull & Jones ..	generator and petrol set)	£1,324
George & Stokes	.. ..	1,417
W. Crosher & Sons	.. ..	1,447
A. & T. Burt, Ltd.	.. ..	1,629

For the generator and battery the tenders were:—

Turnbull & Jones	£1,293	15 0
" " (alternative tender)	1,883	5 0
" " " "	1,325	5 0
George & Stokes	1,442	19 0
W. Crosher & Sons	1,453	17 9
A. & T. Burt, Ltd.	1,579	0 0

It was resolved to accept Messrs. Turnbull & Jones's tender, in the sum of £1,324 11s., for the generator and petrol set, subject to the distributing board and fittings being to the satisfaction of the city engineer.

Burnley.—The T.C. has accepted the tender of Messrs. Siemens Bros., Ltd., to supply 1,600 yd. of ·15 in. cable and 800 yd. of ·075 in. cable, at £270 12s. 4d.

Bovey Tracey.—Messrs. Lord & Shand, of Plymouth, have secured the contract for the construction of a high-pressure electric power line from Bovey Tracey to Haytor, in connection with the lignite works of the Ilsington Mining Co.

France.—The French Post and Telegraph authorities in Paris have just placed contracts as follows:—
La Compagnie Generale d'Electricité, Paris.—100 tons high-conductivity copper wire, 2 mm. diameter, at 2,400 fr. per ton.
La Compagnie Francaise des Metaux, Paris.—50 tons, at 2,370 fr., and 50 tons, at 2,345 fr.
Les Forges de France Comte, Besançon.—50 tons, at 2,370 fr.
M. Grammont, of Pont de Cheruy (Isere).—50 tons, at 2,390 fr.
La Compagnie des Trefileries du Havre.—50 tons, at 2,350 fr., 50 tons, at 2,364 fr., and 50 tons, at 2,397 fr.
La Compagnie Francaise du Bi-Metal, Paris.—50 tons, at 2,359 fr.

Glasgow.—In addition to the cable contract which Messrs. Johnson & Phillips, Ltd., Kent, have received for the Renfrew workshops of the Clyde Navigation Trustees, they have also received an order for electric cable and conductor installation at the new Rothesay docks, the value of which is between £8,000 and £9,000.

The Tramways Committee has accepted the following offers:—
British Thomson-Houston Co.—Spare oil switch parts.
Geo. M'Lellan & Co.—Sand hose pipes.
Simplex Conduits, Ltd.—Insulated tubing, &c.
J. A. Rudd & Co.—I.R.V. taped and braided cable.
The Fairbanks Co.—Triplex chain blocks.
Forest City Electric Co.—Copper bonds.

Southampton.—The T.C. has accepted the tender of Messrs. Babcock & Wilcox, Ltd., for the supply of a boiler for the electricity works, at £1,680.

(*Continued on page* 980.)

ELECTRICAL MINING PLANT.

That the doings of makers of electrical mining plant have a tendency to be "wropt in mystery" cannot be denied; this applies, at least, to British manufacturers, who carry out much more work in this direction than is generally supposed. As a case in point, a glance through the works of Messrs. Scott & Mountain at Gateshead will convince any inquirer as to both the above facts.

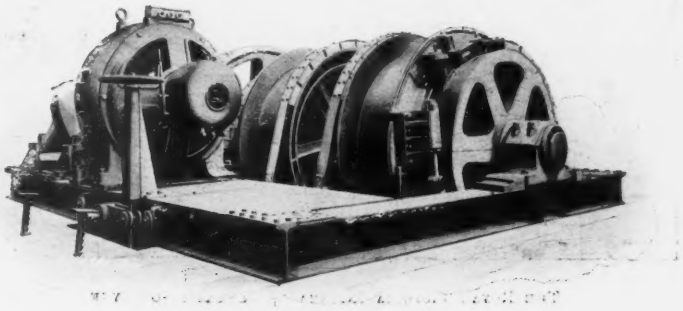
A speciality of the above firm consists in haulage plants, one of which we illustrate herewith, it being one of three sets supplied to a Midland colliery.

The gear, as will be seen, is of a very massive construction, the drums being 6 ft. dia. × 2 ft. wide, mounted on a main shaft 11 in. dia., with 10 in. dia. bearings. The gear is driven by a 200-H.P. electric motor fitted with slip-rings, and drives through machine-cut spur gear on to the first-motion shaft of the haulage gear, the spur gear being enclosed in an oil bath.

The firm's special type of friction clutch is fitted, this clutch consisting of a revolving brake-strap, lined with hard wood blocks, operating on to a fixed driver on the main shaft; the clutches are controlled by a weigh-bar with screw and hand wheel.

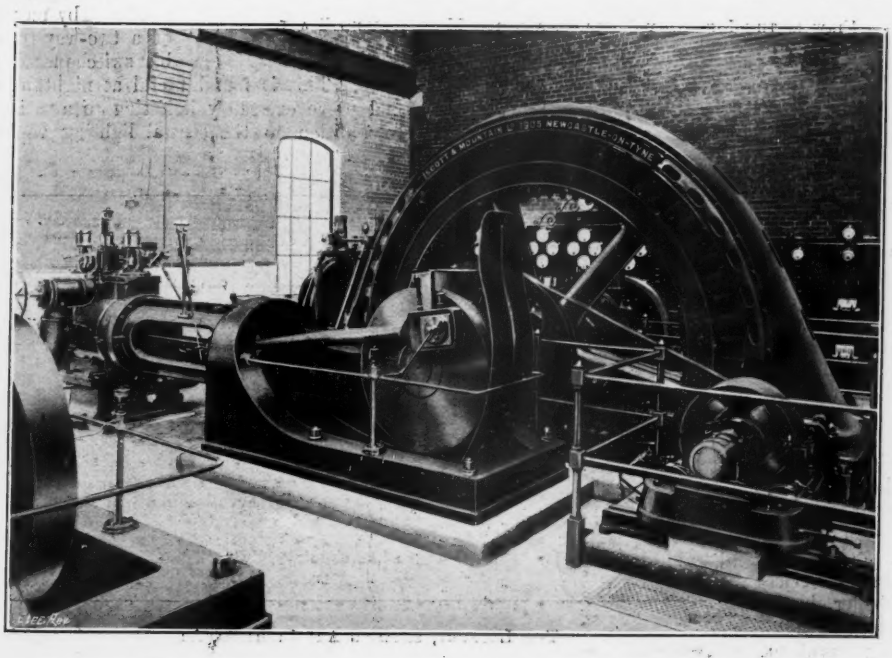
The other two gears for the same installation are of the double-drum main rope and endless rope type respectively; that shown in the illustration being of the main and tail type, while all the motors are of 200 H.P., and of similar type.

In another view we show one of three alternators made by the same firm for a colliery in the Midlands. These sets generate 3-phase current at 500 volts pressure, with a periodicity of 50 cycles per second, and have an output of 360 K.V.A. The armature rings are of very massive design, being about 15 ft. diameter, while the revolving magnets are mounted direct on the engine crankshafts, forming the fly-wheel of the engine.



Scott & Mountain 200-H.P. Haulage Plant.

The generator fields are in each case energised by a small exciter, rope-driven from a small pulley on the engine crankshaft, which is shown in our illustration.



Fly-wheel Type Alternator supplied to a Midland Colliery by E. Scott & Mountain.

THE ELECTRICAL INSTALLATION AT THE ROYAL VICTORIA INFIRMARY, NEWCASTLE-UPON-TYNE.

The problems of hospital arrangement as far as they affect electrical engineering, provide an interesting study in lighting and power supply of an entirely specialised nature. The needs of a hospital include lighting, motive power, electro-medical appliances, telephones, signalling apparatus and other branches of electric practice. Conditions enter into design for hospital work that are not found elsewhere, and it is, therefore, interesting to examine some features of the electrical equipment of the Royal Victoria Infirmary at Newcaste-upon-Tyne.

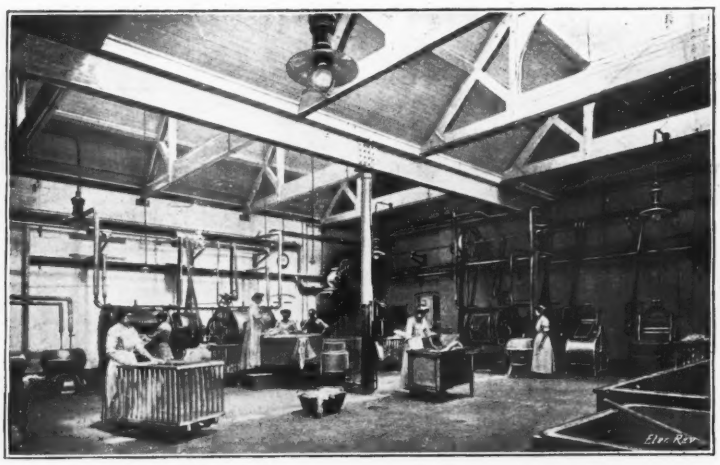
The building, which is one of the largest and most up-to-date hospitals in the world, accommodating about 400 in-patients and the large staff required to deal with them, as well as providing for a large out-patient department, has now been in operation for some months, so that the electrical arrangements about to be described

have been under test, and the resultant application of electricity may be fairly described as being conducted under normal conditions.

The hospital consists, firstly, of an administration block,

The Royal Victoria Infirmary, Newcastle-on-Tyne.

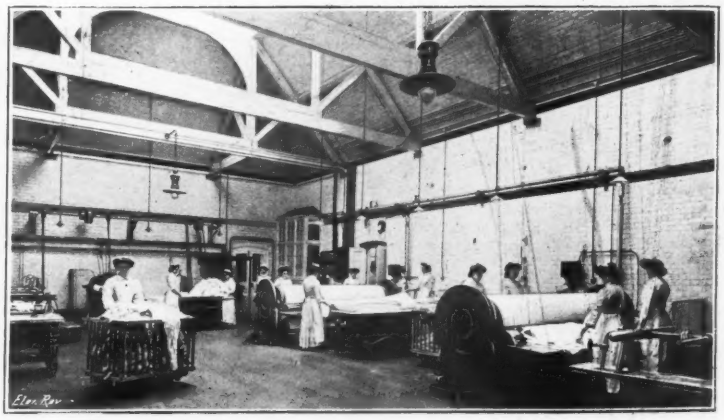
containing the board room, medical library, students' department, medical and surgical offices, dining hall for resident officers, sisters, staff nurses and probationers, kitchens and sculleries, bedrooms for female servants, and other rooms. This block occupies the centre and front of the group of buildings. Immediately at the back of this block run the main corridors to each extremity of the building. Branching off from these corridors are, at the front, two large pavilions containing on the ground floor surgical wards for men and women respectively, of 24 beds each, and on the first floor, two medical wards of similar capacity. Added to these there are at the front two smaller pavilions, one having on the ground floor a 10-bed female surgical ward, and on the first floor a similar medical ward, the other being devoted to childrens' surgical and medical cases on the ground and first floor respectively. At the back of the corridors are six pavilions, four large, two small, each containing a ward on each floor following the arrangement indicated above, *i.e.*, surgical cases on the ground floor, medical on the first floor. A building, semi-detached from the range of erections just described, and reached from the hospital through a tasteful winter garden, is set apart as the nurses' home, and contains sitting rooms, bedrooms, &c. Other departments are the operating theatre and class room, mortuary, chapel, skin department (which is of special electrical interest), out-patients' department, casualty room, and such service departments as laundry, boiler house and workshops. The total length of ground covered by the buildings is about 850 ft. with a depth of about 400 ft.



View in the Infirmary Laundry, showing Motor-driven Plant.

It is necessary to give the above somewhat extended general description in order to comprehend the magnitude of the problems to be solved in the proper electric equipment of the hospital. The whole of the internal lighting is by electricity, no other illuminants being used. There are about 2,000 incandescent lamps of 16 c.p., and 9 arcs (in use in the laundry) fed by a three-wire (240 and 480-volt) continuous current service from the mains of the Newcastle and District Electric Lighting Co., Ltd. There are 65 distribution boards in various parts of the building, the fuses to the different circuits being arranged systematically on these boards. All the interior wiring is carried out in screwed steel tubing concealed under the floors or behind the walls and rendered accessible by means of inspection boxes. The mains from the two main fuseboards to the distribution boards, made by Messrs. Callender, are of concentric lead-covered armoured and braided type, and are hung in saddles in the subways, running up to the boards in iron pipes. One main board provides for six lighting circuits and five power circuits, the other giving nine lighting circuits and four power circuits. The total provision is for 800 amperes at 240 volts and 290 amperes at 480 volts. Two separate services run into the building from the company's network.

The lighting fittings are as a rule of a very plain and useful description, the style adopted being observable in the illustrations accompanying this article showing the ward lighting. In the wards a special arrangement of wiring is installed, whereby either a dim or bright light can be obtained on the centre brass pendants by means of a two-way tumbler switch placed at one end of the ward. This is found useful at night, as a bright light would prove extremely irritating to a patient seeking rest. In addition to the central lighting of the wards, a specially-designed wall bracket is placed over each bed, while wall sockets are provided at every other bed for use with standard or hand lamps. The principle of



The Laundry, showing Arc Lighting, &c.

simplicity in lighting fittings, has, however, been departed from to a considerable extent in the board-room, entrance hall, library and other important rooms, where some very elegant designs are introduced. A particularly interesting example, in view of the special study which scientific illumination is now receiving, is the hospital chapel. The dome of this building, which is cruciform in shape, is richly gilt, and illuminated by a ring of concealed lights placed just underneath it, the effect in general illumination being most rich. The lighting of this chapel is further helped by fittings finished to imitate armour hung from the arches.

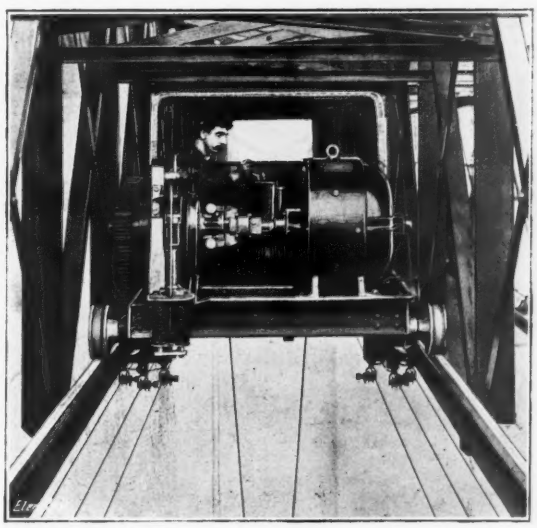
In the operating theatres considerable trouble has been taken to obtain a light that can be easily adjusted so as to be thrown on to any required spot, and in addition a system of emergency lighting patented by Mr. H. McGillivray, of Newcastle, has been installed. This is a special switching arrangement, whereby, should the light from the ordinary switch fail, thereby endangering an operation, the emergency light, of precisely the same candle-power, but lit from secondary cells, will automatically be brought into use. In the subways electric lights are freely installed in order to avoid danger of fire by use of naked lights. Meters are fixed in various parts on the building in order to check any waste of current.

The motive power required in the infirmary is pretty extensive. Lifts are provided in the administrative block, the nurses' home, and pavilions Nos. 1 and 2. They are five in number, that in the nurses' home being operated by press-button. Two of those in the main block of buildings are capacious bed-lifts, while the remaining two serve the kitchen (situated on the top floor of the administrative block in order that all smell of cooking may be kept from the patients), and are used for conveying the dinner wagons for the wards. The electrical equipment for these lifts was supplied by Messrs. Waygood & Co.

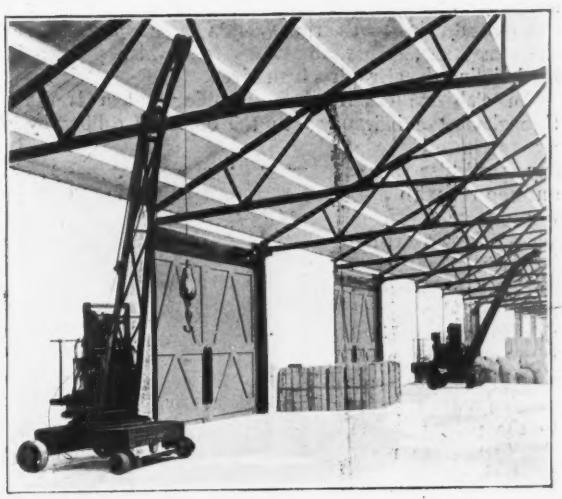
A motor-generator is installed for the electrical treatment department, transforming the 480-volt pressure to 55 volts, with a variation of 5 volts in either direction. This is for use with the radiographic apparatus, electric baths, Finsen lamps, and for Rontgen ray work in skin diseases. In addition to these uses of power, electric motor drive is used for operating kitchen machinery, dispensary plant such as rotary mixers, the laundry machinery, part of which with the motor drive is shown in our illustration, and also in the Infirmary workshop where a lathe, driller, &c., are kept pretty constantly employed in effecting minor repairs and alterations on the engineering work of the premises. Fans for ventilating the buildings are fixed in each ward and various other parts of the buildings. Complete outfits for cautery and other purposes are installed in the operating theatres and in the out-patients' department, and the voltage and fitments of these outfits is such that small electric lamps may be used from them in order to get close inspection of the complaints of the throat, ear, &c. In the eye examination room, which is coloured a dead black, electric lamps are arranged in each compartment with special reflectors for directing a strong beam into the patient's eye. One interesting device for cases of alleged colour blindness is a small sign executed in various coloured transparent letters lit from behind at will. Combination of certain letters spell one word, others spell another. The patient is asked to pronounce the word he sees, and he thus tests himself for defective colour sight. In connection with eye treatment may also be mentioned a powerful electro-magnet whose pole is narrowed to a point. This is used for drawing particles of iron out of the eye that have become lodged therein. As Newcastle is the centre of a large engineering district this device is of an eminently useful nature.

In addition to the larger branches of electrical work mentioned above, the telephoning and signalling arrange-

View showing the General Lighting of the Wards.

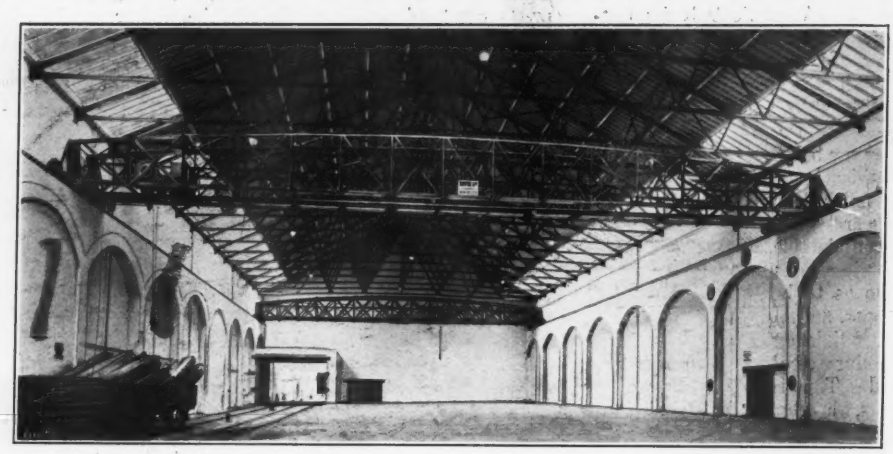


Warehouse Cranes: Driver's Cabin and Gear, Royce 25-cwt. Traveller (see page 979).



Portable Warehouse Cranes by Stothert & Pitt (see page 979).

ments are, as may be imagined when the vast area covered by the Infirmary is considered, of an important nature. A complete system of telephonic communication proceeds from an exchange in the porter's lodge in the administration block to about 40 instruments fixed at various points in the buildings, so arranged that communication can be obtained between any two points. The microphones and telephones were supplied by the British L. M. Ericsson Manufacturing Co. The telephone installation in the Nurses' Home is entirely separate from the main exchange. There is, of course, ample telephone service to the infirmary from the National Telephone Co.'s mains in the city.



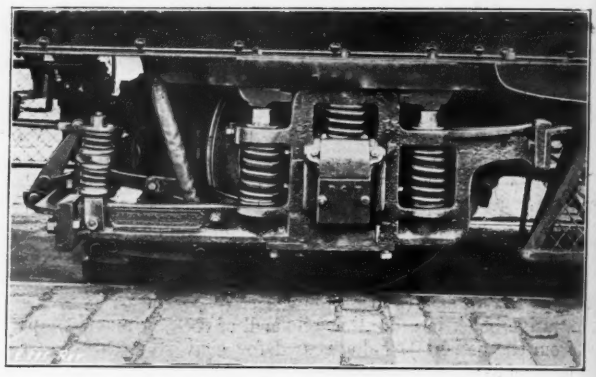
Royce 25-cwt. Travelling Cranes for a Manchester Ship Canal Warehouse (see p. 979).

In addition to the telephones, speaking tubes are fitted for the lifts, in order to communicate readily between floors. The system of fire alarms is very complete, and consists of special pushes fixed in glass-fronted cases, arranged so that when the glass is broken an alarm is given at a central point by the ringing of a large gong, while, at the same time, an indicator shows from which position in the building the alarm has been given.

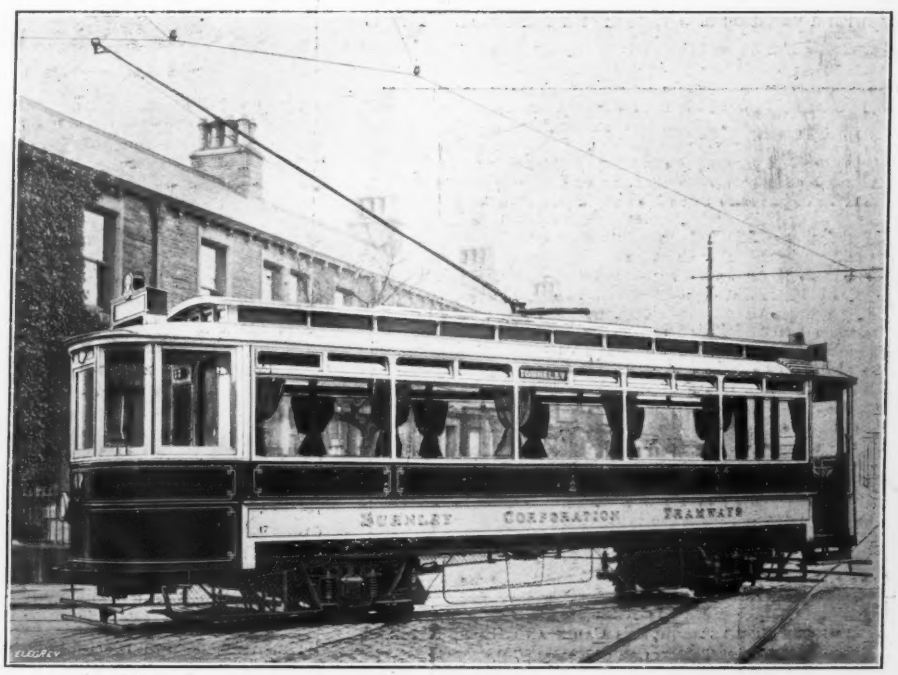
An elaborate electric bell signalling system is fitted throughout the infirmary with the object of calling, by a prearranged code, any particular house surgeon who is urgently required, in whatever part of the building he may happen to be. In the out-patients' department this has been combined with a special lamp-signalling device, so as to give visible notice to the patients when the doctors are ready to see them.

In such a large organisation, with a multiplicity of duties, it is highly essential that perfect time-keeping should be maintained. For this purpose an installation of electrical clocks, made by the Synchronome Syndicate, Ltd., consisting of a master clock in the entrance hall controlling about sixty dials, has been placed in the hospital. A dial is fixed in every ward, in the principal rooms of the administrative block and in the corridors, while over the entrance of the outdoor patients' department an illuminated outside dial is placed.

The architects for the building were W. Lister Newcombe, F.R.I.B.A., and H. Percy Adams, F.R.I.B.A., while the contractors for the whole of the installation of the lighting and power circuits, and also the telephone, fire alarm and electric clock systems, were Messrs. Falconer, Cross and Co., of 16, Lisle Street, Newcastle-upon-Tyne. The magnitude of the work which this firm carried out may be illustrated by the fact that about eighty miles of electric lighting cable were used in the building, and over 100,000 ft. of tubing was placed in position for the reception of these wires. The installation is a most complete example of up-to-date equipment for hospital purposes, and very clearly shows the important part which electricity now plays in medical and surgical work.



The Simpson-Park Radial Truck (see p. 979).



View showing a Burnley Car fitted with Simpson-Park Radial Trucks (see p. 979).

SOME MODERN WAREHOUSE CRANES.

On pages 977-8 we illustrate an interesting type of 25-cwt. three-motor electric overhead travelling crane, two of which are installed at each of four of the Trafford Park warehouses of the Manchester Ship Canal Co., Ltd. Each of these cranes (constructed by Messrs. Royce) has the exceptionally large span of 95 ft. 3 in., and, by reason of the fact that a clear height of lift of 30 ft. is required, the girders have been made of the bow-string type, and so arranged that the crab is inside. The platform is fixed along the entire length of one side of the girders, and is carried by means of a separate light auxiliary girder. The view on page 977 shows the inside of the crane girder with the crab in position. The driver rides with the crab, and is thereby enabled to have the best possible view of all the operations. Light netting guard is fixed over that portion of the crab where the driver sits, so as to prevent any possible accident to the man when standing up during the time the crab is in motion. The speeds are :—

Hoisting, 25 cwt.	100	ft. per min.
„ with light loads	200	„ „
Longitudinal travelling, 25 cwt.... ...	50	„ „
„ „ with light loads	75	„ „
Cross traversing, 25 cwt.	250	„ „
„ „ with light loads ...	320	„ „

The controllers, resistances and emergency switches, are carried on the crab, and are arranged for convenient handling ; and an electric hoisting brake is provided, with a device by which it can be released by hand and the loads lowered without current. The hoisting barrel is spirally grooved with right and left-hand grooves to keep the load in a central position throughout the entire lift, and the axles for cross traversing and longitudinal travelling are provided with roller bearings. The hoisting motion is provided with an effective overwinding safeguard, and to prevent loads being lowered at a speed dangerous for the gearing or motor, a governor lowering gear is provided on the first motor shaft. These cranes have been submitted to a series of exhaustive official trials for a continuous period of five hours ; the load of 25 cwt. was hoisted at 118 ft. per min., the electric H.P. absorbed being 13·9, giving an overall efficiency of 71·7 per cent. The cross traversing with 25 cwt. was at the rate of 353 ft. per min., the electric H.P. absorbed being 3·48. In the longitudinal travelling 25 cwt. were taken at 104 ft. per min., the electric H.P. absorbed being 1·74, giving a tractive effort of 33 lb. per ton. In another view on page 977 are shown two of several small electric portable cranes, which have recently been provided by Messrs. Stothert & Pitt, at the Western Dock of the London and India Docks Co. These cranes are of a design which appear specially adaptable for warehouse working, inasmuch that each crane is mounted on a truck fitted with broad running wheels suitable for running on the floor of the warehouse, whilst the front pair of wheels is made to swivel. Each of the cranes illustrated lifts 20 cwt. at a 10 ft. 6 in. radius, the lifting and sluing motions being operated by the same motor and the derricking being adjusted by hand power. The lifting speed is 50 ft. with a 1-ton load, whilst the slewing speed is 100 ft. per min. The sluing gear is so arranged with double friction combs that it is unnecessary to reverse the motor when sluing.

A NEW RADIAL TRUCK.

A considerable amount of interest has been recently shown in the development of a type of truck, to which the name "radial" or "flexible wheel base" truck has been assigned. The object of such trucks is to provide a longer wheel-base, so as to afford greater support to the car-body, and prevent the end oscillation so often noticeable in cars carried on the usual single trucks with wheel-base limited to 6 ft.

Another object aimed at in the adoption of radial trucks is the reduction of wear of wheels and rails when the cars are passing round curves. A number of forms of "radial" truck have been constructed and put into operation, with more or less satisfactory results. The nature of their design, however, limits their application to comparatively short wheel-bases, and therefore to short cars.

A radial truck which, it is claimed, is a distinct advance on previous types, has been recently constructed under the Simpson & Park patent, and has been running since September 10th on the Burnley Corporation Tramways, with very satisfactory results.

The wheel-base of the car is exceptionally long, the distance between wheels being 18 ft. This car is capable of passing easily round a curve of 25 to 30 ft. radius. The peculiar feature of the truck is the readiness with which the axles take up an approximately true radial position when passing round a curve.

This action is due to the design of truck in combination with a differential gear fitted to the axles. The following is a general description of the truck, which is shown in the illustrations on p. 978.

Two single-axle trucks are used to support a car-body, and as each truck is entirely independent of the other, the wheel-base can be proportional to the length of the car. Each truck is pivoted at a point in the centre line of the axle, a king pin and bracket being attached to the car-body underframe to take the drive. Between the car-body and truck frame, rollers are interposed so as to reduce the friction and allow the truck to radiate easily. The arrangement of springs is practically the same as on a Brill type maximum traction truck. The wheel brake blocks are hung as near to the centre line of the wheel as possible. On the trucks in use at Burnley, a mechanically applied track brake is fitted, and also a run-back preventer on the axle, but a magnetic track brake can be arranged for if required. The differential gear on each axle is arranged in combination with the usual gear-wheel, and is enclosed by the motor gear case. This gearing enables each wheel when passing round a curve to work independently of the other, and facilitates the movement of the truck into the correct radial position.

The following advantages are claimed for this truck :—

1. The position of the pivotal centre being over the centre line of the axle, as wide a range of angular movement as required can be obtained without danger of any part of the truck fouling the car-body underframe.

2. The length of the wheel-base can be proportioned to suit the length of the car, whatever this may be, there being practically no limit to length of wheel-base in this design.

3. Wear between wheel flanges and rails, and the tendency to unequal wear between the diameters of the two wheels on one axle is greatly reduced, due to the differential action.

4. Due to the use of the differential gear, the twisting strains on the axle are diminished.

5. The weight of car is considerably less than one of similar capacity carried on eight wheels.

6. Less sand is required for accelerating and braking than would be necessary in the case of maximum traction trucks.

7. There would be a reduction in current consumption and cost of maintenance as compared with a car designed to do the same service, mounted either on maximum traction trucks or on equal wheel trucks with four motors.

Selling Electricity to Warships.—It is not often that vessels of the United States Navy are central station customers. With ships at sea there would be some difficulty in connecting with the street mains of any electric light station at home, while during the stay in port the isolated plants on shipboard are still relied upon. But in the case of the U.S.S. *Newark* and *Granite State* turned over to the New York State Naval Militia, and moored to a pier in the Hudson, the situation is different, and the State of New York has recently made a contract with the New York Edison Company to supply electric light and power to these vessels. A cable of the underground type is run from the street connection out on the pier and through a standpipe which is raised about 8 or 10 ft. above the pier. From the end of the standpipe, flexible cables are extended in the case of each vessel, and through these the current is led to the switchboard on board ship. The *Newark* is a new-old 4,000-ton steel cruiser 17 years old and was considered a crack ship in its day. It still belongs to the Navy, and, should it be required by the Government, must be ready to put to sea on 48 hours' notice. The *Granite State* is a survivor of the days when there were wooden line-of-battle ships.—*Western Electrician.*

CONTRACTS CLOSED.

(*Continued from page* 974.)

London.—The Metropolitan Asylums Board has received the following tenders for alterations and extensions to the fire alarms and telephones at Gore Farm Hospital:—

T. Potter & Sons	(accepted)	£225
W. G. Cannon & Sons		226
Electrical Engineering & Maintenance Co. ..		239
Private Wire & Telephone Installation Co. ..		278
J. Bryden & Sons..		287
Bell Telephone & Electric Co.		335
H. Hooper		373
Revy, Phillips & Co.		397

The engineer-in-chief's estimate was £235.

WOOLWICH.—The B.C. has received the following tenders for cable required for an extension to the Ordnance College:—

	Delivery	
St. Helens Cable & Rubber Co.	3 weeks	£175
British Insulated & Helsby Cables, Ltd.	1 month	169
Siemens Bros. & Co.	1 day	167
Johnson & Phillips, Ltd.	5 weeks	167
Callender's Cable & Construction Co. ..	8 weeks	166
Henley's Telegraph Works Co.	10 days	166
Western Electric Co. .. .. (accepted)	14 days	164

HOLBORN.—A B.C. Committee has accepted the tender of Messrs. Foote & Milne, the contractors, for the electric lighting work throughout the new offices, for the provision of a service of telephones and bells, at a cost of £131 for telephones, and £29 10s. for bells. Three tenders were received, and that named was the lowest.

L.C.C.—The tender of the India-Rubber, Gutta-Percha and Telegraph Works Co., which was the lowest, has been accepted by the Highways Committee of the L.C.C. for the supply of 600 rubber plough bases, at 56s. each, and 1,200 plough leads, at 4s. 3d. each.

Manchester.—The following tenders have been accepted by the Electricity Committee and approved by the City Council:—

British Westinghouse Co.—Supply of three 250-K.V.A. and one 25-K.V.A. transformer for sub-station at Messrs. Andrew & Bramall's Mill, Carruthers Street, Ancoats.
Eckstein, Heap & Co.—Supply of necessary high and low-tension switchgear for sub-station at same mill.
Callender's Cable & Construction Co.—Vulcanised bitumen cables to June, 1909.
W. T. Glover & Co.—Lead-sheathed high-tension cable.

Salford.—The undermentioned tenders have been accepted by the Corporation Tramways Committee:—

United Electric Car Co.—20 car-bodies, at £448 12s. 6d. each.
Hurst, Nelson & Co.—Four car-bodies, at £458 17s. 6d. each.
Mountain & Gibson, Ltd.—23 trucks, at £64 10s. each; one truck, at £110.
British Westinghouse Co.—24 electrical equipments, including trolley bases, at £279 each.
S. Rawlinson & Sons.—Four salt wagons, at £125 each.
General Electric Co.—Electric fittings at Salford Town Hall.

Sheffield.—The T.C. has accepted the tender of Messrs. Edgar Allen & Co. for the supply of tramway points and crossings.

Tunbridge Wells.—We are informed that 25 tenders were received in answer to the Corporation's advertisement, to Mr. Boot's specification, and that the Corporation has accepted the tender of the British Westinghouse Co., at £2,575 10s., for the 500-KW. turbo-alternator, and that of Messrs. J. P. Hall & Sons, Ltd., at £865, for the condensing plant.

West Ham.—The E.L. and Tramways Committee has approved the extension for two years of the contract with the British Westinghouse Co. for the supply of transformers and meters, and of a new contract being entered into with the company for two-phase motors. The contract with the Fuller Electrical Co. for single-phase motors is to be extended for two years from March 31st next.

FORTHCOMING EVENTS.

To-day's Events (Friday, December 13th).—At 8 p.m. Holborn Restaurant (King's Hall). Electro-Harmonic Society Smoking Concert.
Physical Society Exhibition of Electrical and other Apparatus. (See "Notes," December 6th.)
From 3 p.m.—At the smaller Queen's Hall. Electro-Therapeutical Section of the Royal Society of Medicine; Annual Exhibition, followed by Conversazione.

Saturday, December 14th.—At 3 p.m. Junior Institution of Engineers. Visits to the Franco-British Exhibition Buildings, &c.; the Exhibition extension works of the Central London Railway; and Central London Railway power house at Shepherd's Bush.

Tuesday, December 17th.—At 8 p.m. Liverpool and District Electrical Association. "Electrical Appliances" (Lantern Lecture), by Mr. J. J. Richardson.

Wednesday, December 18th.—At 7.30 p.m. At the Institution Library. Institution of Electrical Engineers, Students' Meeting. Paper on "Wattmeters and their Connections," by Mr. G. C. Connon.

Thursday, December 19th.—At 7.15 p.m. At the University, Leeds. Institution of Electrical Engineers. Leeds Local Section. Paper on "The Commercial Aspects of Power Supply," by Mr. W. B. Woodhouse.
At 8 p.m. At the Institution of Civil Engineers. Institution of Electrical Engineers. Paper on "Electrical Power in Railway Goods Warehouses," by Mr. H. Henderson.

NOTES.

"E.R." Xmas Week Arrangements.—We shall be glad if our friends will kindly take note of the following special arrangements that have had to be made to facilitate the production of the issue of the ELECTRICAL REVIEW for Christmas week. All editorial matters will have to be closed two days earlier than usual.

Correspondence and Urgent Articles should reach us by mid-day on Saturday, December 21st.

Late Business Items, News, Contract and other notes should be received in the course of Monday, December 23rd.

The Advertisement Department announce elsewhere that new copy and alterations to existing displayed advertisements should be received by them not later than Friday morning, December 20th; but official notices and small prepaid advertisements will be in time if received by 9.30 a.m. on Tuesday 24th inst.

The Power to Drive Twist Drills.—Experiments have been made at the Worcester Polytechnic (U.S.A.), on the power necessary to drive twist drills. The testing machine measures both the turning moment and the thrust of the drill. The drill itself was fixed to the spindle of a milling machine, and the work piece was held in a chuck carried on the machine table. The thrust was found by means of an indicator which registered the pressure in an oil cylinder, the plunger of which carried the thrust of the drill. The twisting moments were obtained by actual weights hung over the chuck. With a feed of 0·008 in. per revolution at 260 R.P.M., a $\frac{3}{4}$ in. drill with an angle of 59° drilled with a thrust of 330 lb. into soft gray cast-iron. The general conclusions from the numerous tests were that thrust increases rapidly with the coarser feeds; that less power is required to perform a given work in a given time by increasing the feed than by increasing the speed. Less thrust was necessary with more pointed drills, but at the half-angle of 37°, the drill did not stand up to repeated work. An angle of 45°, however, seems as good as 59° as regards standing, and the thrust is much less. The twisting moment did not seem to vary with change of the point angle. A leading hole of $\frac{1}{10}$ in. diameter reduced the thrust of a $\frac{3}{4}$ drill to one-half. The experiments are interesting as showing what may be done in the way of making tests to determine the best form and speed of tools for the more rapid performance of work in the shops.

A Novel Theory in Evaporation.—In a pamphlet published some time ago by M. Wichersheimer, Ingenieur en Chef des Mines, a curious theory is advanced on the subject of vaporisation. It is that by increasing the density of the water inside a boiler by the addition of certain soluble salts, the evaporative efficiency of the boiler will be increased without harmful effects. The salts he more particularly recommends are the chlorides of calcium and of sodium. The addition of a salt to water is well known to augment its molecular tension and therefore to raise its boiling point. Thus the addition of 10 per cent. of calcium chloride will raise the boiling point to 101° C., and the addition of 325 per cent.—so soluble is this salt—will raise the boiling point to 179·5° C. This is the saturation point temperature, and such a huge amount of the salt is not asked for. Prior to the use of the salt, however, a dis-incrustant is advocated, which is composed of tannin, mucilaginous matter and barium chloride. The latter is converted into insoluble barium sulphate when lime sulphate is present in the feed water, while the lime carbonate is partially converted into tannate, and this remains in suspension. The old scale on the plates is said to be removed in sheets by the compound.

The author states that when water is boiled in a vessel and little fragments of paper are thrown in, these will ultimately find themselves at the bottom of the water next the shell of the vessel. This proves that, though perhaps violent ebullition is in progress, there must be a thin layer of water adherent by capillarity, which will not move. The circulation is insufficient to destroy the adhesion. Peclet largely increased the evaporation by rubbing the surface of a boiler with brushes so as to keep the whole of the water moving over the heated surface, and artificial circulation has been shown to be effective in promoting evaporation. Ordinarily evaporation is unsteady, and steam comes away in large bubbles, and in jumps. But if an active circulation sweeps the plates evaporation is steady, steam escapes in more numerous and smaller bubbles, and priming is reduced. He might add that the effect of fully-heated feed water is probably to assist the steady continuance of rapid circulatory movements, and this may serve to explain the better efficiency secured even when a boiler is made to heat its feed water by the agency of its own steam. Small steam bubbles are less potent than large bubbles to cause priming, and this tends to economy in the engine room also.

The author tested his theory in the laboratory by heating three flasks under the same external conditions. In one was Seine water, in another a solution of 10 per cent. of calcium chloride, and in a third water from a boiler which had been treated with the boiler compound named, and containing that compound and calcium chloride. In the first flask the water boiled tumultuously, and bits of immersed paper moved very irregularly. The third flask showed irregular ebullition with small bubbles of equal size, and paper fragments followed a regular course. In the second flask the condition was intermediate but approached No. 3 in behaviour, and showed the good effect of increased density upon evaporation. Various trials under industrial conditions are quoted which show

improved efficiency to result from the use of calcium chloride to the extent of increasing the density of the water to 12°, 15° and even 18° Beaumé.

The subject is a curious one, and seems to deserve full attention, especially since it is expressly declared that no acid formation was found to ensue, such as will sometimes take place when chlorides are present in water. Experiment is wanting, perhaps, to determine the evil effect of various combinations of salts. There is some reason to suppose that mischief attends upon the salts of magnesia in so far as decomposition may set free acids.

Appointments Vacant. — Electrical engineer for the Carlisle Corporation (£300); mains foreman for Birmingham (45s.); switchboard attendant for Stockton-on-Tees (27s. 6d.); assistant clerk of works for installation at South Shields Municipal Buildings (£3 3s.); chief clerk for the Mansfield electricity department (35s.); lecturer in electrical engineering for the School of Military Engineering at Chatham; junior demonstrator for the Central Technical College, Exhibition Road (£100). See our "Official Notice" pages for particulars.

Late Legal.—Sexton *v.* London United Tramways. —Before Mr. Justice Lawrence and a special jury in the King's Bench Division, on Wednesday, Mrs. Emma Sexton, a widow, claimed under Lord Campbell's Act. against the London United Tramways Co., Ltd., for the loss of her husband. It was alleged that the deceased was driving a cart along the Uxbridge Road on the night of January 18th last, when a tramcar belonging to the defendant company collided with his cart, and he was thrown out and fatally injured. The defendants denied that their car collided with the cart which they said had collided with another cart during a dense fog which prevailed on the night in question.—The plaintiff was awarded £300 damages.

Servian Electrical Trade.—In a recent report the Austro-Hungarian Consul at Belgrade states that the trade of Servia in electro-technical goods in 1906 was not unimportant. The imports amounted to 201,306 kilogs., valued at 438,850 fr. as follows: —From Austria-Hungary, 92,228 kilogs., valued at 198,970 fr.; from Germany, 64,728 kilogs., valued at 164,845 fr.; from Belgium, 37,881 kilogs., valued at 56,944 fr.; from France, 5,078 kilogs., valued at 10,461 fr., and from Switzerland, 1,069 kilogs., valued at 5,647 fr. The imports of dynamo machines amounted to 86,873 fr., valued at 147,230 fr., chiefly from Germany (70,205 fr.); from Belgium (41,337 fr.), and Austria-Hungary (33,798 fr.). The imports of transformers amounted to 66,671 kilogs., valued at 64,137 fr., chiefly from Austria (45,510 fr.), and Germany (14,932 fr.). The imports of small motors, &c., and cables were much smaller, the former amounting to 1,993 kilogs., valued at 8,935 fr., from Austria and Germany; and the latter to 9,907 kilogs., valued at 30,921 fr., from Austria, Germany, and Belgium. Telegraph and telephone apparatus and accessories were imported to the extent of 14,499 kilogs., valued at 105,027 fr., chiefly from Austria (68,071 fr.), Germany 23,651 fr., Belgium 7,885 fr., and Switzerland 3,353 fr. The imports of arc lamps amounted to 3,125 kilogs., valued at 15,214 fr., and of incandescent lamps to 2,038 kilogs., valued at 16,763 fr. The imports of accessories for lighting purposes amounted to 16,200 kilogs., valued at 50,623 fr. The imports of arc lamps were chiefly from Germany and Austria, of incandescent lamps from Germany and Austria, and of accessories for lighting purposes from Germany, Austria, France and Belgium.

Free Wiring Dispute.—In January last the Southwark Council approved the spending of £500 in free-wiring consumers' premises, in the hope that that policy would attract small customers, especially the residents on the new estate built by the Ecclesiastical Commissioners in St. Peter's Ward, Walworth. In October the Electric Light Committee asked permission to spend another £500 and presented a report showing that both the past results and future prospects of the policy were excellent. The Council consented; but members now contend that in 65 out of 72 tenements free-wired on the Commissioners' Estate no electric light is used; that the fact, had it been disclosed, would have influenced the Council when considering the application for the second £500; that the expenditure has been useless; that lamps are being supplied and maintained by the Council on the private lock-up thoroughfares on the estate at less than one-fourth of their cost; and that very large sums have been spent in cutting through asphalt and taking up and relaying pavement in order to supply isolated consumers. The statements have been referred for reply to the electrical engineer, who said that he was unaware of any free-wired premises where the Council had not got a consumer.

Institution and Lecture Notes.—Institution of Electrical Engineers (Newcastle Local Section).—In his address as chairman of the Section on November 18th, Mr. J. Pigg dealt broadly with the subject of education. He deprecated the common error that the acquirement of knowledge is education; true education had to take note of man's spiritual, moral and intellectual needs, as well as the more material needs such as obtaining the means to live, and had to fit a man for all phases of life, building up his character so that he might contribute his quota to the general well-being. More depended upon the student than upon the system; the youth who wanted knowledge would get it, and the effort which would take him along must always come from himself. The incentive of gain was neither a worthy nor a sufficient stimulus for the sustained effort that was necessary. It was the duty of every one to do the best that he was capable of. The engineer must develop the faculties of observation and imagination; of organisation and knowledge of men. Tact was the greatest of the qualities necessary for a director of men. A due appreciation of the value of words, and a knowledge of accounts, were also of great importance. The engineer must exercise correct judgment in the allocation of costs, and foresight with regard to possible future developments. Cultivation of the things that went to the formation of "character" was of more importance than Ohm's law.

Royal Institution.—We have now received the following more complete information concerning the lecture arrangements of this Institution, to which a brief reference was made last week:—

Friday, January 17th, at 9 p.m.—"The Centenary of Davy's Discovery of the Metals of the Alkalis," by Prof. T. E. Thorpe.

Saturdays, January 18th and 25th, at 3 o'clock.—"The Electrification of Railways," by Prof. Gisbert Kapp.

Friday, January 31st, at 9 p.m.—"Recent Researches on Radio-Activity," by Prof. E. Rutherford.

Friday, February 21st, at 9 p.m.—"The Ether of Space," by Sir Oliver Lodge.

Friday, March 6th, at 9 p.m.—"Recent Earthquakes," by Prof. J. Milne.

Saturdays, March 7th, 14th, 21st, 28th and April 4th and 11th, at 3 p.m.—Six lectures on "Electric Discharges through Gases," by Prof. J. J. Thomson.

Thursdays, March 19th and 26th, at 3 p.m.—"Standardisation in various Aspects: (1) Mechanical Engineering; (2) Electrical Engineering," by Dr. R. T. Glazebrook.

Friday, March 27th, at 9 p.m.—"Radio-active Change in the Earth," by Hon. R. J. Strutt.

Friday, April 3rd, at 9 p.m.—"The Modern Motor-Car," by Lord Montagu of Beaulieu.

Friday, April 10th, at 9 p.m.—"The Carriers of Positive Electricity," by Prof. J. J. Thomson.

Full information concerning admission to these and the many other interesting events announced in the official list of arrangements, can be obtained on application to the Hon. Secretary, Sir William Crookes.

The Insurance and Actuarial Society of Glasgow.—At a meeting of this society held last week, Mr. T. Crighton Fulton read a paper on "Electricity: Where the Risk comes in." He said that he proposed to treat the risks associated with electricity into two classes—preventable and unpreventable. Amongst the former were the fusing of gas pipes through arcing from steel or other metal tubes which had become "alive" or charged with electricity from a leaky conductor. This constituted a grave risk, and was responsible for about 40 per cent. of the electrically caused fires in Glasgow. Amongst other risks treated of by the lecturer were those due to bad workmanship, faulty material, materials and apparatus wrongly or carelessly erected, apparatus and fittings erected in wrong places. Most, if not all, of these risks could be obviated or minimised by careful supervision, inspection, and testing by competent engineers at the time the work was done, and especially by inspection at intervals to detect in time dangers due to the deterioration of materials. Amongst the so-called unpreventable risks, the lecturer classed all those that arose after the contractor was away from the job and the proprietor or consumer left to the freedom of his own will.

British Science Guild.—This Guild is to hold its annual meeting at the Mansion House on January 15th.

East London College.—On Thursday, December 19th, Prof. J. T. Morris will deliver a lecture on "The G.B. Surface-Contact System of Electric Traction for Tramways." A notice regarding application for free tickets appears in our advertisement pages.

Association of Engineers-in-Charge.—On Wednesday last a paper was read by Mr. Leon Gaster on "The Province of the Illuminating Engineer."

Fatality.—According to a London newspaper, Edward Thornton, aged 41, an engineer employed at Sandringham House electric light works, was assisting other men to remove an inlet valve from a gas engine, when he was overcome by the fumes, and despite the efforts of the King's doctors, quickly succumbed. A verdict of "Accidental asphyxiation by the inhalation of noxious gas" was returned.

The Electrolytic Treatment of Galena. — This subject was recently investigated by Mr. H. S. Auerbach, in the Metallurgical Laboratory of the School of Mines of Columbia University, who relates his conclusions, in conjunction with Mr. E. F. Kern, in the School of Mines Quarterly for November.

The authors find that fused alkali chlorides or fused calcium chloride serve as electrolytes for the cathodic reduction of galena. An E.M.F. of about 5 volts is required for the decomposition of the alkali chlorides and sulphides, whereas about 20 volts is required for calcium chloride and sulphide.

Fused calcium chloride, however, has an advantage over fused alkali chlorides for the cathodic reduction of galena, in that it is less readily volatilised, and is also a more fluid bath.

At temperatures above 1,300° C., the fused alkali and calcium chlorides rapidly attack sand and clay crucibles, forming a hard glassy slag. Below 1,000° C., the crucibles are scarcely affected other than by becoming impregnated with the fused salts.

A higher current efficiency is obtained when a fused electrolyte of cryolite and fluorspar is used, due to the fact that aluminium does not readily alloy with lead, for which reason it floats on the lead and is in more intimate contact with the galena than is the case with sodium or calcium, both of which readily alloy with lead.

A great disadvantage of the use of fluoride electrolytes is that the bath becomes quite viscous with use, which is due, no doubt, to the solubility of lead sulphide in the molten mass.

The chlorides have an advantage over the fluorides in that when the bath becomes contaminated with foreign matter, such as SiO_2, CaO, FeO, &c., the chloride salts may be dissolved by water and recrystallised.

The highest current efficiencies, when chloride electrolytes were used for the cathodic reduction of galena, were obtained when the temperature of the electrolyte was highest. The high temperature is necessary to bring about reaction between the galena and the alloy of lead with either sodium or calcium.

No lead is lost by volatilisation during the cathodic reduction of galena in a fused electrolyte, as the reduced lead is covered with a bath of fused salts, which is below the boiling point of the metal.

Fused electrolytes containing lead salts, even though having lower freezing points, are not suitable for the cathodic reduction of galena, because as lead stands lower in the E.M.F. series than the alkalis and alkaline earths, it would be the first constituent to decompose, thus robbing the electrolyte of the constituent which lowered its freezing point.

Finsbury Fire.—Yesterday morning a fire that occurred at Tabernacle Street, Finsbury, did serious damage to overhead telegraph and telephone lines. The majority of the telephone cables connecting to London Wall telephone exchange were stated to be down. As usual, the Press says that fusion of electric wires was the cause of the fire.

P.O. Engineering Department.—The annual dinner of this department is to be held on Tuesday, February 18th, at the Grand Hotel, Trafalgar Square, W.C.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. R. D. SPURR has been appointed resident engineer at the Derbyshire and Nottinghshire Electric Power Co.'s generating station, Ilkeston.

The following appointments have been made at the Grantham Electric Light Works (Urban Electric Supply Co., Ltd.): Chief assistant, MR. R. Q. SEYMOUR; general assistant, MR. F. EVANS, from Market Drayton.

MR. A. MULLINER, one of the assistant engineers in the Southport Corporation electricity department, has been appointed assistant electrical engineer for the borough of Eccles.

Tramway Officials.—The Halifax B.C. last week decided, after discussion, to amalgamate the tramways and electricity management under MR. W. M. ROGERSON, the electrical engineer.

The Tramways Committee of Sheffield T.C. has recommended that the salary of MR. H. E. YERBURY, chief electrical engineer in the tramways department, be advanced from £400 to £450 per annum.

COUNCILLOR R. Y. BANKS has been appointed chairman, and COUNCILLOR F. A. K. HOUNSELL vice-chairman, of the Bournemouth Corporation Tramways Committee for this year.

General.—MR. WILSON WHITING recently left for Hong Kong to take up the post of assistant to the chief engineer in the electrical department of Messrs. Butterfield & Swire. There were 200 applicants for the position.

It is with deep regret that we learn that LORD KELVIN has been confined to his bed for more than a fortnight. Wednesday's papers stated that his lordship's condition caused anxiety. Yesterday an improvement in his condition was announced. We all profoundly hope that that improvement will be maintained.

Obituary.—It is with deep regret that we learn from *L'Electricien*, of Paris, of the death of MONSIEUR JOSEPH-CLEMENT-MARIE LAFFARGUE. The deceased gentleman, who was for some time a valued contributor to the ELECTRICAL REVIEW, was at the time of his death editor of *La Nature*. Professionally he was an electrical engineer, and had control of certain French municipal electrical works. His death occurred on November 26th, at the early age of 43 years.

We regret to record the death, which occurred on November 22nd, of MR. MARTIN WALTON BROWN, who was secretary of the North of England Institute of Mining and Mechanical Engineers, from 1891 to 1907. Mr. Brown was 53 years of age.

We regret to state that a promising career has been cut short by the death, at the age of 26 years, of MR. ANDREW BENNET, JUN., of the burgh electricity department at Partick. For six years he had been connected with that department, where he was a most popular member of the staff. His death occurred on October 5th, the result of an attack of appendicitis.

NEW COMPANIES REGISTERED.

W. H. A. Robertson & Co., Ltd. (95,906).—This company was registered on December 2nd, with a capital of £6,000 in £10 shares, to acquire the Lynton Engineering Works, Bedford, the business of mechanical and electrical engineers, founders, contractors, merchants, repairers of engines, pumps, compressors and machines, manufacturers and constructors of auxiliary machines for rolling mills, complete rolling mills, electrical machines and fittings and boilers, &c. The first subscribers are:—G. Mathieson, Hackney Wick Works, N.E., manufacturer, 50 shares; J. G. Mathieson, A.M.I.C.E., Bryn Coed, Chingford, N.E., 50 shares; S. H. Lane, Worton Manor, Isleworth, merchant, 50 shares; Mrs. A. Lane, Worton Manor, Isleworth, 50 shares; W. H. A. Robertson, 22, Elliott Road, Selly Oak, Birmingham, engineer; A. Horn, Clarnico Works, Victoria Park, N.E., manufacturer, 20 shares; and R. S. A. Housden, Heronden, Shortlands, Kent, merchant, 20 shares. No initial public issue; the number of directors is not to be less than three or more than five; the first are J. G. Mathieson, A.M.I.C.E., S. H. Lane, and W. H. A. Robertson; qualification, 20 ordinary shares; the company is to insure for its own benefit the life of W. H. A. Robertson in the sum of £2,000. Registered office, Lynton Works, Bedford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

W. Sisson & Co., Ltd. (82,295).—This company's annual return was filed on November 2nd, when 2,075 preference, 11,351 ordinary and 7,000 deferred had been taken up out of a nominal capital of £25,000 in 5,000 preference, 13,000 ordinary and 7,000 deferred shares of £1 each; £1 per share has been called up on 2,075 preference and 5,901 ordinary, and £7,976 has been received; £12,450 is considered as paid on 5,450 ordinary and 7,000 deferred. Mortgages and charges: Nil.

Treforest Electrical Consumers' Co., Ltd. (94,335).—This company's annual return was filed on November 7th, when 30,000 shares had been taken up out of a nominal capital of £100,000 in £1 shares; 5s. per share has been called up, and £7,500 has been received. Mortgages and charges: Nil.

Walter's Electrical Manufacturing, Ltd. (94,300).—This company's annual return was filed on October 17th, when 10,507 shares had been taken up out of a nominal capital of £13,000 in £1 shares; £1 per share has been called up on seven and 5s. per share on 500, and £132 has been received; 10,000 shares are considered as fully paid. Mortgages and charges: £4,100.

Coatbridge and Airdrie Electric Supply Co., Ltd. (89,178).—A mortgage or charge dated November 28th, 1907, to secure £6,650, has been registered. Property charged:—The company's undertaking and assets, present and future, including the Coatbridge and Airdrie undertakings, the benefit of agreements for lighting and contracts with consumers (if any) and other benefits, and uncalled capital. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C.

Illuminated Signs, Ltd. (London), (85,543).—Issue on December 2nd of £300 7½ per cent. debentures, part of series created same date, to secure £500, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Electrolytic Alkali Co., Ltd. (Middlewich), (64,360).—Issue on November 14th, of £200, and on November 25th, of £500 debentures, part of series created July 9th, 1904, to secure £50,000, charged on the company's undertaking and property, including uncalled capital. Trustees: Liverpool Mortgage Insurance Co., Ltd., 6, Castle Street, Liverpool. Previously issued of same series: £33,100.

Electric Vehicles Development Co., Ltd. (London), (90,213).—Issue on November 28th of £1,399 4 per cent. debentures, part of series created September 26th, 1906, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,610.

Maxim Electrical Co., Ltd. (84,426).—This company's annual return was filled on November 13th, when 7,247 shares had been taken up out of a nominal capital of £50,000 in £1 shares (30,000 preference). £1 per share has been called up and £7,266 10s. has been received, including £22 10s. paid on 115 shares forfeited, £8 remains in arrears.

Issue on November 28th, of £800 5 per cent. debentures, part of series created May 16th and November 29th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £14,200.

Tasker, Sons & Co., Ltd. (78,374).—This company's annual return was filed on November 19th, when 5,039 ordinary and 7,315 preference shares had been taken up out of a nominal capital of £50,000 in 20,000 preference and 30,000 ordinary shares of £1 each; £3,054 has been paid and £9,300 is considered as paid. Mortgages and charges: Nil.

A. F. Mander, Ltd. (Electrical engineers, Aston Manor) (95,261).—A 5 per cent. debenture dated November 6th, 1907, to secure £300, charged on the company's property, including uncalled capital, has been registered. Holder: A. F. Mander, 62, Victoria Road, Aston.

James Keith & Blackman Co, Ltd. (electric, heating and ventilating engineers, London, Leeds, Birmingham and elsewhere) (31,964).—Issue on November 25th of a £750 4½ per cent. debenture, part of series created August 9th, 1901, to secure £30,000, charged on the company's undertaking and property, present and future, including uncalled capital. Trustees: W. K. Macdonald, Arbroath; and H. G. Anderson, Park House, Wimbledon, S.W. Previously outstanding of same series: £29,250. A memorandum of satisfaction in full of debentures, dated December 5th, 1902, securing £750, has been filed.

Brook, Hirst & Co., Ltd. (electrical engineers, Chester) (95,264).—Issue on November 20th of £7,000 5 per cent. debentures, part of series created same date, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees.

Drake & Gorham, Ltd. (70,275).—This company's annual return was filed on November 16th, when the entire capital of £125,000 in £1 shares had been taken up. £85,000 has been received, and £40,000 is considered as paid. Mortgages and charges: Nil.

Monte Video Telephone Co., Ltd. (27,208).—This company's annual return was filed on November 11th, when 86,492 preference and 72,680 ordinary shares had been taken up out of a nominal capital of £160,000 in 87,000 preference and 73,000 ordinary shares of £1 each. £159,172 is considered as paid. Mortgages and charges: Nil.

Consolidated Signal Co., Ltd. (71,141).—This company's annual return was filed on November 13th, when 214,195 preference and 150,548 ordinary shares had been taken up out of a nominal capital of £425,000 in 220,000 preference, and 205,000 ordinary shares of £1 each. £1 per share has been called up on 27,840 ordinary and 24,999 preference, and £52,839 has been received. £311,904 is considered as paid on 189,196 preference and 122,708 ordinary. Mortgages and charges: Nil.

Electrolytic Alkali Co., Ltd. (64,360). — This company's annual return was filed on November 23rd, when 99,965 preference and 201,304 ordinary shares had been taken up out of a nominal capital of £500,000 in 200,000 preference and 300,000 ordinary shares of £1 each. £1 per share has been called up on 99,965 preference and 126,904 ordinary, and £27,000 15s. has been received, including £131 15s. paid on 35 preference and 314 ordinary shares forfeited. 75,000 ordinary shares considered as fully paid. Mortgages and charges: £33,800.

Ferranti, Ltd. (83,718.)—This company's annual return was filed on November 8th, when 53,374 preference, 60,000 ordinary and 10,000 deferred shares had been taken up out of a nominal capital of £130,000 in 60,000 preference, 60,000 ordinary, and 10,000 deferred shares of £1 each. £123,374 is considered as paid. Mortgages and charges: £139,075.

Reliance Works Co., Ltd. (electrical and general engineers, Southampton) (81,358).—Issue on November 21st of £200 5 per cent. debentures, part of series created June 25th, 1907, to secure £2,000, charged on the company's property, present and future, including uncalled capital. No trustees. Previously issued of same series: £1,000.

Cryselco, Ltd. (electric lamp manufacturers, Bedford) (58,218).—Issue on November 18th of £500 4½ per cent. first debentures, part of series created June 26th, 1905, to secure £10,000 (including £3,000 representing debentures issued in 1898), £5,000 being first and £5,000 second debentures. Property charged: The company's undertaking and property, present and future, including uncalled capital, and land at Kempston, Bedford, with the Kempston Works thereon. Trustees: A. Baker, Billiter House, Billiter Street, E.C.; and H. S. Deacon, Kempston, Bedford. Previously issued of same series: £8,500.

REVIEWS.

The Proell Steam Calculator. London: Jno. J. Griffin and Sons, Ltd. Price 5s.

This book or pamphlet, with its three separate sheets of graphic charts, is an attempt to put into good shape the calculation of the steam consumption of engines and turbines and other matters.

The method involves the employment of some 18 scales, and the pamphlet describes how these may be used simply by the aid of a straight-edge laid across the scale charts. Examples of the method of use are given; thus, if temperature T and pressure C are known, the total heat I is at once found. But our friend entropy comes in, and we fear that much that these scales endeavour to find is obscured by practical difficulties, and that many calculations can be nothing but approximations.

One of the calculations is as follows: Given the pressure P and the total heat I, to determine if the steam is wet or dry. This sounds simple, but how is the total heat of any mass of steam to be known? We may, of course, assume that the steam possesses the total heat for a certain volume of initial steam that has been expanded down to a lower pressure, but in view of practical cylinders and heat exchanges, this does not seem to help us much.

SMOKE PROBLEM IN LARGE TOWNS.

A DISCUSSION has recently been in progress at the Royal Sanitary Institute on the interminable question of smoke, interminable, because as regards the domestic fire there is no cheap grate that will prevent smoke with bituminous coal, though the expensive Arnott bottom-feed grate will prevent, or very greatly mitigate it; and again, while it is easily preventable in boiler furnaces, few engineers who have to do with such furnaces take sufficient interest in the matter to build suitable forms.

Much has of late been heard of coalite, which is partly-coked coal, or bituminous coal that has been converted into an artificial form of short flaming coal. But coalite is hardly novel, and Mr. Scott-Moncrieff claims that he made such a material 25 years ago.

Dr. Rideal put in a special plea for coalite and coke, both of which he claimed to be free from sulphur, and he seemed to complain of the present law, which allows gas to be sold with so much sulphur in its composition. He also objected to the use of electricity for heating, because, he said, electric stations made more dirt and sulphur than came from the coal burned in ordinary grates. The electric station ought to burn bituminous fuel smokelessly. This is done at one London station. Why cannot equally good engineering be practised at other stations? Enough is known to prevent smoke without loss, but boiler-owners will not attend to the matter because they can plead that the smoke they make is not really dark enough, and so they get off.

Mr. Goodenough pointed out that American flats were equipped with gas ranges, the charge being included in the rent, but Dr. Dudfield deplored gas ranges, because the coal fire was so fine a refuse destructor, and without it the dust-bin became a fly pestilence with all that followed. Obviously, when gas is the fuel of a house, the collection of refuse will have to be differently ordered. Dr. Rideal did not, however, really complain of sulphur in gas, for there were, after all, only 4,000 grains per 10,000 cb. ft., but in a ton of coal there were 350,000 grains of sulphur.

No matter how smokelessly coal is burned, the sulphur from it all goes into the air. But sulphur does not, like soot, produce thick fogs. Like the poor, the smoke problem is always with us, but it is of our own choosing. We could stop it if we really cared to do so, but so long as we allow any man to pollute our air and are content to breathe the dirty stuff, that man will continue to do so.

CITY NOTES.

The Adelaide Electric Supply Co., Ltd.

THE directors' report for the year ended August 31st, 1907, states that a further 6,000 preference shares of £5 each were offered for subscription in August last. The whole were allotted to the public in Adelaide, which the directors regard as eminently satisfactory, as showing the degree of confidence which the company enjoys locally. The cost of the issue, including underwriting, commission and advertising, was £2,401. The profit and loss account shows a profit for the year of £9,319. After payment of the dividend on the preference shares for the half-year ended February 28th, 1907, writing £526 off suspense account, the latter consisting of the cost of the last two issues of preference shares, and placing a sum of £1,000 to depreciation account, there remains, including the amount carried forward from the previous year, an available balance of £6,336. The dividend on 15,000 6 per cent. preference shares for the half-year ended August 31st required £2,250; a dividend of 2½ per cent. on 26,065 ordinary shares for the year ended August 31st required £3,256, and £830 is carried forward. During the year, a sum of £22,266 has been expended in Australia on capital account in the provision of additional buildings, plant and mains. The directors are continuing their policy of including the residential districts surrounding the city of Adelaide in the company's field of operations, and for this purpose the supply mains are being gradually extended into such districts as are expected to yield additional revenue. Owing to delay on the part of the manufacturers in delivering the necessary additional generating plant, the arrangements for closing down the small station at Port Adelaide and supplying that district from the company's principal station at Adelaide, could not be completed during the past year. The change-over, however, took place on October 12th last, and Port Adelaide is now being supplied from Adelaide, with a consequent substantial reduction in the working expenses. The directors have recently been advised by cable that the Adelaide Municipal Tramways Trust has accepted the company's tender for a temporary supply of power to the various systems of tramways which are now being electrified. It is anticipated that this contract will prove an important source of revenue to the company. The following table illustrates the progress made at Adelaide during the past four years:—

Date.	Lighting in 8-C.P. lamps.	Motors in rated H.P.	Total connections (in 8-C.P. lamps).
At August 31st, 1904	28,502	654	49,430
At August 31st, 1905	34,050	911	63,202
At August 31st, 1906	39,396	1,119	75,204
At August 31st, 1907	45,254	1,384	94,462

American Telephone and Telegraph Co.

ACCORDING to the New York *Electrical World*, a letter has been issued to stockholders of this company by President Theodore N. Vail, who, in speaking of the company's gains in earnings, says that, for the 10 months ended October 31st, 1907, the net earnings were $13,715,000, against, for the same period in 1906, $11,579,000. October showed net earnings of $2,567,000, against $2,004,000 for October, 1906. The company has cash in banks of over $18,000,000, and will not have to do any financing until the requirements of 1909. The company has earned, in the first 10 months, its entire 8 per cent. dividend for the year upon its enlarged capital, with a balance of nearly 1 per cent. to spare. A fairer comparison of earning capacity would be to take as the average amount of stock outstanding during the 10 months the $131,551,400 issued at the beginning of the year, plus the first 50 per cent. payment on the $21,925,200 stock offered in June, making a total of $142,514,000. On this basis the percentage of earnings was 9·6 per cent., as compared with 8·8 per cent. last year. The $13,715,000 of net earnings shown above does not by any means measure the full earning power of the parent company. For instance, on September 30th, at the

end of the first three quarters of the current fiscal year, there was a balance in round figures of $6,000,000, representing the undivided earnings of the 30 odd associate companies. The American Telephone Co.'s share in this total may be roughly figured at 55 per cent. —its percentage of the total outstanding stocks of all the subcompanies—or say $3,300,000. The addition of this sum to the actual net earnings of $13,715,000 gives a total of over $17,000,000, or better than 11 per cent. on the full amount of stock now issued.

British Westinghouse Co.

The *Financial Times* publishes the following:—"It was unfortunate for the British Westinghouse Electric and Manufacturing Co. that, just as it was surmounting the operating troubles . . . . . its American parent should find its own financial affairs temporarily involved and be able no longer to help the English company with additional capital. Under these circumstances it became necessary for the British Westinghouse directors to provide for the company's maturing liabilities; this they propose to do by the issue of £300,000 prior lien bonds, to sanction which the debenture stockholders are called to attend a meeting on the 18th inst. At October 31st the company owed to its bankers £152,000, to the American companies £185,000, and to other creditors £166,000. If the debenture stockholders sanction the prior lien issue, the American companies will accept Traction and Power Securities Co. shares at par in settlement of their accounts, and the British company will be enabled to meet its other liabilities, have £40,000 in hand for the requirements of its expanding business, and £50,000 prior lien bonds in reserve. The circular states that the company has more than earned the interest on its debenture stock and advances since January 1st last, and that the Merchants' Trust, as trustees for the debenture stockholders and holders of £20,000 of the stock, consider that the plan offers the best solution of the present position. Under the circumstances, it is argued that the other debenture stockholders would be securing the best prospect of getting back their money by giving their support to the proposal. They will thus get rid of £185,000 of debt on favourable terms, they will release the company from the burden of the remainder of its unfunded debt, and leave it free, with £90,000 in hand, to see what success it can achieve under its improved management."

The Manx Electric Railway Co., Ltd.

An extraordinary general meeting of the shareholders of this company was held on Tuesday at the offices, 78, Cornhill, Mr. A. G. Boscawen presiding.

The Chairman, in proposing the adoption of the report (see below), said the receipts during the year showed an increase of £1,066, and the working expenses an increase of £1,016. The increased receipts were satisfactory as far as they went, and the increased working expenses were largely due to the extra money they had been obliged to spend on coal for two reasons. In the first place, owing to the fact that the winter was a very dry one, they were obliged to employ steam instead of water power for a considerable period, which necessitated the use of an increased amount of coal; and in the second place, the price of coal had been considerably higher than usual. On the whole, he thought they might be satisfied that they had tried successfully to secure additional traffic on the line and also to economise. The visitors to the island increased from 471,785 in 1906, to 477,444 this year; an increase of 5,721, equal to 1·2 per cent. On the other hand, the passengers carried by their railway had increased from 535,021 to 546,666, an increase of 11,645, equal to 2·1 per cent. It was also satisfactory to notice that though they had carried more passengers, their passenger mileage showing a decrease of 8,072 miles run during the year. Although on the year they were only apparently about £50 better off, they had really done much better. Last year they had to meet certain very heavy items of special expenditure due to the unfortunate accident which occurred the year before at Snaefell, and the subsidence of part of that section of the railway. To meet those charges £2,003 was paid out of revenue last year, and this year they had had no special expenditure. They had kept up all the rolling stock and permanent way in a most efficient manner, and they had also put aside £1,500 to the reserve for special renewals, which fund now stood at over £4,000, and they thought they were quite justified in paying 1 per cent. on the ordinary shares, which would leave £1,201 to carry forward. They had continued to do everything that lay in their power to attract passengers, and had this year purchased two motor char-a-bancs, which were running between the Bungalow and Sulby Glen. The vehicles had not been running long enough for them to reap the full advantage this year, but so far the results had proved very satisfactory, and they looked forward to building up a new traffic which would be of great advantage to the company. The question of the electrification of the front at Douglas was still unsettled. Some two years ago they offered to do the work, or to lease the trams and convert them into electric trams on terms which they considered to be very fair to the Corporation, but their offer was not accepted on the ground that the Corporation would rather do the work themselves. However, nothing had been done until quite recently, when some of the more enlightened members of the Corporation had pressed forward the matter, and he believed estimates were being obtained for the installation of the necessary plant. Their offer was still open, and he could not but believe that it would be more advantageous to the ratepayers to accept a supply from them, than for the Corporation to go to the expense of putting down their own plant.

Sir W. H. Vaudrey seconded the motion, and the report was adopted.

The report for the year ended September 30th, 1907, showed gross receipts amounting to £35,345, and gross expenditure of £16,773, which left a gross balance of £18,572, plus £1,270 brought forward. Debenture interest required £9,000; interim dividend of 2¾ per cent. per annum on preference shares absorbed £3,566; amount placed to reserve for special renewals, £1,500; and the balance of preference share dividend, £3,566, leaving £2,210, out of which the directors proposed to pay a dividend of 1 per cent. on the ordinary shares, which would amount to £1,000, carrying forward £1,210. During the year the only capital expenditure was £749, the balance due for rolling stock purchased in 1906. Certain expenditure had been made in connection with the purchase of two motor char-a-bancs (running between the Bungalow and Sulby Glen) and the building of a motor shed for same, &c.; this the directors did not propose to treat as ordinary capital expenditure, but to liquidate gradually by writing off a certain proportion annually for depreciation. The weather in the Isle of Man during the earlier part of the past summer season was very bad, but, in spite of this, the number of passengers carried during the 12 months totalled 546,666, as compared with 535,021 during the previous 12 months, an increase of 11,645 passengers. The receipts during the past year were £35,345, as against £34,279 in the previous year, whilst working expenses amounted to £16,773, as compared with £15,756, and the ratio of working expenses to receipts was 47 per cent. in 1907, as compared with 46 per cent. in 1906—the increase being largely due to increased cost of coal.

Aron Electricity Meter, Ltd.

The meeting of this company was held on Tuesday at Winchester House, E.C., under the chairmanship of Mr. H. Hirst.

The Chairman, in moving the adoption of the report (see Electrical Review, December 6th, page 944), said he hoped it had given the shareholders as much gratification as it had given the board. The figures had again justified their policy. The gross profits were over £2,000 more than last year. The amount written off for depreciation was less than last year, due to the fact that last year they had to write off the expenses consequent on the removal of the London factory to Willesden. The items of directors' fees in arrear and part commission in arrear, were due to the extra 3 per cent. paid in April. The management and secretarial charges included a larger amount of commission owing to the increased turnover. The increased gross profits, and certain economies which he indicated, accounted for the increase in the net profit by about £3,000. As regarded the balance-sheet, on the debit side there were three items which seriously differed from those of last year. The first was the amount of debenture debt, which stood at £41,600, and showed, therefore, a reduction of £7,300. Sundry creditors and outstandings were about £3,000 more than last year, due to the increased purchases required for the larger turnover, and also to the higher price of raw material ruling. The third item was the profit and loss account, which showed £4,000 more. Although the fall in price of raw materials took place after October 1st, which fact would have justified them in presenting these accounts with their raw material at the increased cost price, they had decided to depreciate the stock sufficiently in accordance with the lower prices ruling at the end of October, when they priced the stock, and they had dealt with the drop in the present accounts so that they would not be worried with anything of the kind in the current year. It was not likely that raw materials would suffer a further drop in the near future so as to seriously affect their figures. Sundry debtors were practically the same in spite of the increased turnover, which showed that the business was done with financially sound concerns. The loan against securities at short notice was reduced by just the amount required to pay off the debentures, whilst cash in hand was about £2,000 more. He would like to say a few important words on the general situation of the company. First, what provision was made for the expiry of patents? Secondly, what was included in the item of goodwill, patents, &c.? Thirdly, when would the dividends in arrear be paid? Fourthly, when would the ordinary shares get a dividend? Lastly, how had the various branches done individually? In addition to the patents they originally purchased from Dr. Aron, which were strong enough to prevent anyone attempting to tamper with them, and which, in consequence, secured to them a monopoly of a certain type of meter, they had had to develop other meters, cheaper meters at prices to suit small consumer installations. They had spent nearly every year £600 or £700 for patent fees, and several thousands of pounds for experiments, designs and production of proprietary articles. It was not for him to say whether their patents were worth what they originally stood at in the books, but he had no hesitation in saying that they were worth as much to-day as at any time in the history of the company. As regarded goodwill, it was not generally noticed that the item of £180,000 on the balance-sheet did not only include goodwill or patents, but also land, buildings, machinery, plant, and other very tangible assets. The bigger the business the better the goodwill. They did last year a larger turnover than ever since the formation of the company; they sold more meters in nearly every civilised country, and the goodwill of the company, though standing at less in the books, was certainly greater than at the time of the issue of the prospectus and first balance-sheet. He intended to give the shareholders once for

all a statement about this item of goodwill, &c. It had had the careful attention of the directors all these years, and had not been left untouched, as the equal figures of the balance-sheet might suggest. Since the formation of the company they had put out of revenue into the business the sum of nearly £70,000 in cash. This did not include a sum of £1,000 paid to acquire what they thought might prove a useful patent, nor the shares they received from the American company, but it did include the cash they received from America, about £10,000. It also included about £16,800, which they had spent in additional machinery and instruments, about £11,000 they have spent for land and buildings; about £10,500 for offices and workshop installation; £4,000 for office and workshop furniture; and about £13,600 for tools. In spite of the expenditure of this £70,000, the item on the top of the credit side of the balance-sheet which included goodwill, patents, land, buildings, machinery, tools, &c., stood at £10,000 less than in 1899. Of course, there had been depreciation, but the actual figure for depreciation was a very small percentage only of the actual improvement of their property. The third and fourth questions he could answer together. From the point of profits they had made this year and last, and from the point of liquid assets they still possessed, they could practically pay off the bulk of the dividend in arrear immediately, and the ordinary shares could begin to participate already next year in any profits. In the minds of the directors, however, the process of strengthening the company had to be continued because both from a trading and financial standpoint the competition grew daily keener, the profit on each meter in consequence grew less, and it was necessary to do an ever-increasing business if they wished to make the same or increased profits, and for that purpose more and more capital would be required every year. Secondly, the directors had to face the repayment of the debenture loan at the rate of £5,000 a year. It was quite true that whilst they had it they might repay these debentures out of capital, but the directors must reckon with the fact that paying this £5,000 out made the company £5,000 weaker, and they thought it desirable when considering what dividend should be recommended to reckon with this fact, and it was for that reason they had this year put a substantial amount for a reserve towards goodwill so that they shall not one day be devoid of the necessary working capital. It would be their endeavour to pay at least something of the arrears each year in addition to the standing 6 per cent., and if their anticipation of continued good business were realised, they might one day feel strong enough to make short work of this liability. But they did not feel strong enough to-day, and those who had the continued prosperity of the company at heart would agree with them. Those who held ordinary shares must be patient a little longer, but he firmly believed they would in the long run be rewarded for holding on. As regarded the fifth question, all the branches had contributed to the profits of the company and the London branch, which several years showed a loss had reached the turning point. They had had in London last year 50 per cent. more orders and sales than in the previous year, and they had between October 1st and that day booked orders equal to 50 per cent. of last year, whilst the orders and sales all through the company were also considerably ahead of last year. For the better conduct of the business in Austria, they had formed a company there, similar to those in Germany and France, under the title of Electra, Apparatenbaugesellschaft, G.m.b.H., the whole of the capital of which was in the hands of the company. They had given considerable attention to the Taximeter question, and had produced an instrument of which the Commissioner of Police had approved, and which was now under test at the National Physical Laboratory, and they were making a keen bid for this business in this country and were experimenting in connection with the production of this instrument. The expenses were already written off, and if they were successful in obtaining contracts it would add to the revenue of the company. They had also developed in Germany a business in small motors, which were manufactured at their Schweidnitz works. This business, though showing a loss for the first year, was promising to progress very favourably. He again thanked Prof. Aron, their managing director, as well as the staff, for the intelligence and hard work they had devoted to the business during the last year.

Sir J. Pender seconded the motion.

Mr. Sichel, on behalf of a number of shareholders, protested against the proposal to place £9,000 for the reduction of the goodwills and patent accounts, and especially in view of the statement of the chairman that day. He felt that having got the company out of the mud the board had become ultra-conservative, but he would urge the claim of the ordinary shareholders to get some dividend.

Mr. Rosenheim suggested that the board should wipe out the arrears of directors' fees from the balance-sheet.

The Chairman, in reply, said he thought they ought to write something off the patents, seeing how long the company had been in existence. He was firm in the belief, knowing the requirements of the future, that they were too weak to pay out more than they recommended. None of the directors drew any more than fees in proportion to the amount paid on the arrears of dividend.

The resolution for the adoption of the report was then carried.

Western Electric Co. (U.S.A.).

We learn from the *Western Electrician* that a special meeting of the stockholders of this company was held on November 5th, at Chicago. In accordance with the directors' recommendation an issue of $15,000,000 5 per cent. 25-year bonds was authorised. The bonds will be used both for the extension of the company's business and for the payment of floating indebtedness. It was announced that no part of the issue would be put out at this time. The following information was presented for the information of the stockholders.

"The sales for the first six months of 1907 were $29,614,000, or 1·3 per cent. more than for the first six months of 1906. For the four months ended September 30th, 1907, the sales were $15,745,000, or 35·1 per cent. less than for the corresponding period of 1906.

"The total number of employés on December 1st, 1906, was 26,922, and on October 1st, 1907, 16,183, a decrease of 39·9 per cent.

"Summary of payables less cash, at December 1st, 1906, and October 1st, 1907, is as follows:—

	Dec. 1st, 1906.	Oct. 1st, 1907.	Increase.	Decrease.
Payables ...	$22,881,000	$15,347,000	—	$7,534,000
Less cash ...	1,626,000	3,732,000	2,106,000	—
Total ...	$21,255,000	$11,615,000	—	$9,640,000

"Accounts receivable and undiscounted receivables on hand were at December 1st, 1906, $20,354,000, and at October 1st, 1907, $12,838,000, a decrease of $7,484,000.

"Our inventory of finished merchandise, work in process and raw material at October 1st, 1907, is estimated at $22,000,000.

"The rate of production of telephone apparatus at the factories is still somewhat in excess of the orders from customers, although the number of employés has been reduced 39·9 per cent.

"We know, however, that our telephone customers are using up their own stocks to such an extent that we believe they will soon be placing more orders with us than they are doing at present. The expected additional business from our present telephone customers, together with that which will arise from our sales to independent telephone companies, to whom we are now prepared to sell apparatus freely, will require the present rate of production to be increased and consequently additional hands to be employed."

India-Rubber, Gutta-Percha, and Telegraph Works Co., Ltd.

The directors' report for the year ending September 30th, 1907, to be presented at the meeting to be held on Tuesday next, states that the accounts show, after provision for doubtful debts, a net profit of £56,809 14s. Adding £42,224 brought forward, and deducting £12,500 interim dividend paid in June, there remains a disposable balance of £86,534. The directors recommend the distribution of a dividend of 15s. a share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in June, a total payment of 10 per cent. for the year (the same as for last year), and leaving £49,034 to be carried forward. The general business of the company shows an increase compared with the results of last year. The prices of raw material remained at a high standard until the end of the summer quarter, but since then prices have declined. The Palmer and Persan motor and bicycle tires which are manufactured by the company continue to grow in favour, their merits being more generally recognised. The electrical installation in Dumfries has been completed, and in the future a revenue from this source may be expected. The laying of a cable between New York and Havana, manufactured to the order of the Commercial Cable Co., has been completed since the closing of the financial year. The cable steamers *Silvertown*, *Dacia*, and *Buccaneer* have had employment during the year, and are in an efficient condition. The works at Silvertown and at Persan have been maintained in their usual state of efficiency, and the electrical equipment of the latter has been completed. The Hon. Henry Marsham, on his return from abroad, was appointed a director, a vacancy on the board having been created by Mr. Henderson's death.

Richard Hornsby & Sons.—Mr. H. Simpson Gee, in addressing shareholders at the annual meeting held in London last week, said that the year's turnover was the largest in their records. The amalgamation with the business of Messrs. Andrews, of Stockport, had turned out very satisfactorily. The growth in the demand for suction gas plants had necessitated additions to the Grantham factories, costing £42,000. The company now had more orders on hand than a year ago. There were signs of a falling off in the general trade of the country, among the causes being the financial crisis in America. They had done a much larger export business than ever before. Their Australian trade had shown marked improvement.

Prospectuses.—*Anglo-Sumatra Rubber Co., Ltd.*—This company has been before the public with an issue of 71,300 shares of £1 each, at par. It is to acquire estates in the province of Serdang.

Provincial Tramways Co., Ltd.—This company is making an issue at par of £175,000 5 per cent. first debenture stock. The list is to close to-morrow (Saturday).

Vallambrosa Rubber Co., Ltd.—An interim dividend at the rate of 50 per cent. per annum has been declared for the half-year ended September.

end of the first three quarters of the current fiscal year, there was a balance in round figures of $6,000,000, representing the undivided earnings of the 30 odd associate companies. The American Telephone Co.'s share in this total may be roughly figured at 55 per cent.—its percentage of the total outstanding stocks of all the sub-companies—or say $3,300,000. The addition of this sum to the actual net earnings of $13,715,000 gives a total of over $17,000,000, or better than 11 per cent. on the full amount of stock now issued.

British Westinghouse Co.

The *Financial Times* publishes the following:—"It was unfortunate for the British Westinghouse Electric and Manufacturing Co. that, just as it was surmounting the operating troubles . . . . . its American parent should find its own financial affairs temporarily involved and be able no longer to help the English company with additional capital. Under these circumstances it became necessary for the British Westinghouse directors to provide for the company's maturing liabilities; this they propose to do by the issue of £300,000 prior lien bonds, to sanction which the debenture stockholders are called to attend a meeting on the 18th inst. At October 31st the company owed to its bankers £152,000, to the American companies £185,000, and to other creditors £166,000. If the debenture stockholders sanction the prior lien issue, the American companies will accept Traction and Power Securities Co. shares at par in settlement of their accounts, and the British company will be enabled to meet its other liabilities, have £40,000 in hand for the requirements of its expanding business, and £50,000 prior lien bonds in reserve. The circular states that the company has more than earned the interest on its debenture stock and advances since January 1st last, and that the Merchants' Trust, as trustees for the debenture stockholders and holders of £20,000 of the stock, consider that the plan offers the best solution of the present position. Under the circumstances, it is argued that the other debenture stockholders would be securing the best prospect of getting back their money by giving their support to the proposal. They will thus get rid of £185,000 of debt on favourable terms, they will release the company from the burden of the remainder of its unfunded debt, and leave it free, with £90,000 in hand, to see what success it can achieve under its improved management."

The Manx Electric Railway Co., Ltd.

An extraordinary general meeting of the shareholders of this company was held on Tuesday at the offices, 78, Cornhill, Mr. A. G. Boscawen presiding.

The Chairman, in proposing the adoption of the report (see below), said the receipts during the year showed an increase of £1,066, and the working expenses an increase of £1,016. The increased receipts were satisfactory as far as they went, and the increased working expenses were largely due to the extra money they had been obliged to spend on coal for two reasons. In the first place, owing to the fact that the winter was a very dry one, they were obliged to employ steam instead of water power for a considerable period, which necessitated the use of an increased amount of coal; and in the second place, the price of coal had been considerably higher than usual. On the whole, he thought they might be satisfied that they had tried successfully to secure additional traffic on the line and also to economise. The visitors to the island increased from 471,785 in 1906, to 477,444 this year; an increase of 5,721, equal to 1·2 per cent. On the other hand, the passengers carried by their railway had increased from 535,021 to 546,666, an increase of 11,645, equal to 2·1 per cent. It was also satisfactory to notice that though they had carried more passengers, their passenger mileage showing a decrease of 8,072 miles run during the year. Although on the year they were only apparently about £50 better off, they had really done much better. Last year they had to meet certain very heavy items of special expenditure due to the unfortunate accident which occurred the year before at Snaefell, and the subsidence of part of that section of the railway. To meet those charges £2,003 was paid out of revenue last year, and this year they had had no special expenditure. They had kept up all the rolling stock and permanent way in a most efficient manner, and they had also put aside £1,500 to the reserve for special renewals, which fund now stood at over £4,000, and they thought they were quite justified in paying 1 per cent. on the ordinary shares, which would leave £1,201 to carry forward. They had continued to do everything that lay in their power to attract passengers, and had this year purchased two motor char-a-bancs, which were running between the Bungalow and Sulby Glen. The vehicles had not been running long enough for them to reap the full advantage this year, but so far the results had proved very satisfactory, and they looked forward to building up a new traffic which would be of great advantage to the company. The question of the electrification of the front at Douglas was still unsettled. Some two years ago they offered to do the work, or to lease the trams and convert them into electric trams on terms which they considered to be very fair to the Corporation, but their offer was not accepted on the ground that the Corporation would rather do the work themselves. However, nothing had been done until quite recently, when some of the more enlightened members of the Corporation had pressed forward the matter, and he believed estimates were being obtained for the installation of the necessary plant. Their offer was still open, and he could not but believe that it would be more advantageous to the ratepayers to accept a supply from them, than for the Corporation to go to the expense of putting down their own plant.

Sir W. H. Vaudrey seconded the motion, and the report was adopted.

The report for the year ended September 30th, 1907, showed gross receipts amounting to £35,345, and gross expenditure of £16,773, which left a gross balance of £18,572, plus £1,270 brought forward. Debenture interest required £9,000; interim dividend of 2½ per cent. per annum on preference shares absorbed £3,566; amount placed to reserve for special renewals, £1,500; and the balance of preference share dividend, £3,566, leaving £2,210, out of which the directors proposed to pay a dividend of 1 per cent. on the ordinary shares, which would amount to £1,000, carrying forward £1,210. During the year the only capital expenditure was £749, the balance due for rolling stock purchased in 1906. Certain expenditure had been made in connection with the purchase of two motor char-a-bancs (running between the Bungalow and Sulby Glen) and the building of a motor shed for same, &c.; this the directors did not propose to treat as ordinary capital expenditure, but to liquidate gradually by writing off a certain proportion annually for depreciation. The weather in the Isle of Man during the earlier part of the past summer season was very bad, but, in spite of this, the number of passengers carried during the 12 months totalled 546,666, as compared with 535,021 during the previous 12 months, an increase of 11,645 passengers. The receipts during the past year were £35,345, as against £34,279 in the previous year, whilst working expenses amounted to £16,773, as compared with £15,756, and the ratio of working expenses to receipts was 47 per cent. in 1907, as compared with 46 per cent. in 1906—the increase being largely due to increased cost of coal.

Aron Electricity Meter, Ltd.

The meeting of this company was held on Tuesday at Winchester House, E.C., under the chairmanship of Mr. H. Hirst.

The Chairman, in moving the adoption of the report (see Electrical Review, December 6th, page 944), said he hoped it had given the shareholders as much gratification as it had given the board. The figures had again justified their policy. The gross profits were over £2,000 more than last year. The amount written off for depreciation was less than last year, due to the fact that last year they had to write off the expenses consequent on the removal of the London factory to Willesden. The items of directors' fees in arrear and part commission in arrear, were due to the extra 3 per cent. paid in April. The management and secretarial charges included a larger amount of commission owing to the increased turnover. The increased gross profits, and certain economies which he indicated, accounted for the increase in the net profit by about £3,000. As regarded the balance-sheet, on the debit side there were three items which seriously differed from those of last year. The first was the amount of debenture debt, which stood at £41,600, and showed, therefore, a reduction of £7,300. Sundry creditors and outstandings were about £3,000 more than last year, due to the increased purchases required for the larger turnover, and also to the higher price of raw material ruling. The third item was the profit and loss account, which showed £4,000 more. Although the fall in price of raw materials took place after October 1st, which fact would have justified them in presenting these accounts with their raw material at the increased cost price, they had decided to depreciate the stock sufficiently in accordance with the lower prices ruling at the end of October, when they priced the stock, and they had dealt with the drop in the present accounts so that they would not be worried with anything of the kind in the current year. It was not likely that raw materials would suffer a further drop in the near future so as to seriously affect their figures. Sundry debtors were practically the same in spite of the increased turnover, which showed that the business was done with financially sound concerns. The loan against securities at short notice was reduced by just the amount required to pay off the debentures, whilst cash in hand was about £2,000 more. He would like to say a few important words on the general situation of the company. First, what provision was made for the expiry of patents? Secondly, what was included in the item of goodwill, patents, &c.? Thirdly, when would the dividends in arrear be paid? Fourthly, when would the ordinary shares get a dividend? Lastly, how had the various branches done individually? In addition to the patents they originally purchased from Dr. Aron, which were strong enough to prevent anyone attempting to tamper with them, and which, in consequence, secured to them a monopoly of a certain type of meter, they had had to develop other meters, cheaper meters at prices to suit small consumer installations. They had spent nearly every year £600 or £700 for patent fees, and several thousands of pounds for experiments, designs and production of proprietary articles. It was not for him to say whether their patents were worth what they originally stood at in the books, but he had no hesitation in saying that they were worth as much to-day as at any time in the history of the company. As regarded goodwill, it was not generally noticed that the item of £180,000 on the balance-sheet did not only include goodwill or patents, but also land, buildings, machinery, plant, and other very tangible assets. The bigger the business the better the goodwill. They did last year a larger turnover than ever since the formation of the company; they sold more meters in nearly every civilised country, and the goodwill of the company, though standing at less in the books, was certainly greater than at the time of the issue of the prospectus and first balance-sheet. He intended to give the shareholders once for

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Sir J. Pender seconded the motion.

Mr. Sichel, on behalf of a number of shareholders, protested against the proposal to place £9,000 for the reduction of the goodwills and patent accounts, and especially in view of the statement of the chairman that day. He felt that having got the company out of the mud the board had become ultra-conservative, but he would urge the claim of the ordinary shareholders to get some dividend.

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"The total number of employés on December 1st, 1906, was 26,922, and on October 1st, 1907, 16,183, a decrease of 39·9 per cent.

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India-Rubber, Gutta-Percha, and Telegraph Works Co., Ltd.

The directors' report for the year ending September 30th, 1907, to be presented at the meeting to be held on Tuesday next, states that the accounts show, after provision for doubtful debts, a net profit of £56,809 14s. Adding £42,224 brought forward, and deducting £12,500 interim dividend paid in June, there remains a disposable balance of £86,534. The directors recommend the distribution of a dividend of 15s. a share, free of income-tax, amounting to £37,500, making, with the interim dividend paid in June, a total payment of 10 per cent. for the year (the same as for last year), and leaving £49,034 to be carried forward. The general business of the company shows an increase compared with the results of last year. The prices of raw material remained at a high standard until the end of the summer quarter, but since then prices have declined. The Palmer and Persan motor and bicycle tires which are manufactured by the company continue to grow in favour, their merits being more generally recognised. The electrical installation in Dumfries has been completed, and in the future a revenue from this source may be expected. The laying of a cable between New York and Havana, manufactured to the order of the Commercial Cable Co., has been completed since the closing of the financial year. The cable steamers *Silvertown*, *Dacia*, and *Buccaneer* have had employment during the year, and are in an efficient condition. The works at Silvertown and at Persan have been maintained in their usual state of efficiency, and the electrical equipment of the latter has been completed. The Hon. Henry Marsham, on his return from abroad, was appointed a director, a vacancy on the board having been created by Mr. Henderson's death.

Richard Hornsby & Sons.—Mr. H. Simpson Gee, in addressing shareholders at the annual meeting held in London last week, said that the year's turnover was the largest in their records. The amalgamation with the business of Messrs. Andrews, of Stockport, had turned out very satisfactorily. The growth in the demand for suction gas plants had necessitated additions to the Grantham factories, costing £42,000. The company now had more orders on hand than a year ago. There were signs of a falling off in the general trade of the country, among the causes being the financial crisis in America. They had done a much larger export business than ever before. Their Australian trade had shown marked improvement.

Prospectuses.—*Anglo-Sumatra Rubber Co., Ltd.*—This company has been before the public with an issue of 71,300 shares of £1 each, at par. It is to acquire estates in the province of Serdang.

Provincial Tramways Co., Ltd.—This company is making an issue at par of £175,000 5 per cent. first debenture stock. The list is to close to-morrow (Saturday).

Vallambrosa Rubber Co., Ltd.—An interim dividend at the rate of 50 per cent. per annum has been declared for the half-year ended September.

MARKET QUOTATIONS.

Wednesday, December 11th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	28/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£16	..
a Copper Sulphate	per ton	£23 10	..
a Lead, Nitrate	per ton	£31	..
a ,, White Sugar	per ton	£32	..
a ,, Peroxide	per ton	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (75/80 %)	per ton	£30	..
a ,, Chlorate	per lb.	9½d.	..
a ,, Perchlorate	per lb.	9d.	..
a Potassium Cyanide	per lb.	7d.	..
a Shellac	per cwt.	220/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Chlorate	per lb.	3½d.	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a ,, Cyanide (basis 100 %)	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£168	..
b ,, Wire, in ton lots	per ton	£150	..
b ,, Sheet, in ton lots	per ton	£145	..
v Babbitt's metal ingots	per ton	£55 to £156	..
c Brass (rolled metal 2" to 12") basis	per lb.	7d.	..
c ,, Tube (brazed)	per lb.	9⅜d. to 10d.	dec.
c ,, ,, (solid drawn)	per lb.	8¼d. to 8½d.	dec.
c ,, Wire, basis	per lb.	7¼d. to 7½d.	dec.
c Copper Tubes (brazed)	per lb.	10¼d. to 10⅝d.	dec.
c ,, ,, (solid drawn)	per lb.	10½d. to 10⅞d.	dec.
g Copper Bars (best selected)	per ton	£80	..
g Copper Sheet	per ton	£80	..
g ,, Rod	per ton	£80	..
e ,, (Electrolytic) Bars	per ton	£64	£1 inc.
e ,, ,, Sheets	per ton	£81	£1 inc.
e ,, ,, Rod	per ton	£70	£1 inc.
e ,, ,, H.C. Wire	per lb.	8¼d.	⅛d. inc.
f Ebonite Rod	per lb.	8/8	..
f ,, Sheet	per lb.	8/-	..
n German Silver Wire	per lb.	1/6½	½d. dec.
h Gutta-percha, fine	per lb.	5/5 to 6/6	..
h India-rubber, Para fine	per lb.	3/6	2d. inc.
Iron, Charcoal Sheets	per ton	..	..
i ,, Pig (Cleveland warrants)	per ton	49/9	1½d. inc.
,, Forgings, according to size	per ton	..	..
,, Scrap, heavy	per ton	..	..
l ,, Wire, galv. No. 8, P.O. qual.	per ton	£15	..
g Lead, English Ingot	per ton	£14 15	£4 dec.
g ,, ,, Sheet	per ton	£15 19	81/6 dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 5	£1 dec.
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/2	..
p ,, rolled bars & rods	per lb.	1/2 to 1/3	..
p ,, ,, strip & sheet	per lb.	1/3½ to 1/5	..
o Platinum	per oz.	110/-	..
e Silicium Bronze Wire	per lb.	10d.	½d. inc.
r Steel, Magnet, in bars		£60	..
o Tin, Block (English)	per ton	£127 to £128	£12 dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/10	1d. dec.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£45 to £62	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£26 10	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.
r W. F. Dennis & Co.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended October 25th, 1907, were 535,604, compared with 434,809 units in the corresponding four weeks of 1906.

Blackpool, St. Annes & Lytham Tramways Co., Ltd.—In their annual report the directors mention that in spite of the invariably wet weather throughout the year, the revenue account was only £224 short of last year. The total received for the year was £23,551, and there was a profit of £6,500. Interest on debentures, however, required £7,500, and £1,500 was allotted to the sinking fund, so that the debit balance was increased from £10,036 to £13,053.

STOCKS AND SHARES.

Tuesday Evening.

With only a fortnight intervening between this and the Christmas holidays, it may well be imagined that the Stock Markets are not particularly busy. Spasmodic animation moves prices irregularly, and while a more cheerful tone is adopted with regard to the situation in the United States, the actual position seems to mend but slowly. There is a less general consensus of opinion that the Bank Rate will fall to 6 per cent. before the end of the present twelvemonth.

The electrical industry has to bear the brunt of many reproaches hurled against it for disturbing the peace of the financial world. It was only the other week that attention was drawn here to the statement that the fall in copper, so baneful an influence in the American slump, had been brought about to some extent by depression in electrical industries, with its consequent slackening of demand for the metal. Now it is the people interested in lead who are echoing this complaint. Shares in the silver and lead-producing companies of the Broken Hill district have fallen sensationally during the last six months, the collapse being attributed to the fall in the price of lead, over-produced now that the "electrical industries" are so quiet.

Prices in the sections devoted to electricity are mainly better this week. There is a little investment business doing, and it does not take much spur of demand to make prices improve. There may be comparatively slight inquiry, but this is countered with the fact that holders of stock, unless compelled to realise, prefer to keep their investments until such time as prices will show less depreciation.

Telegraph issues maintain their firmness, with improvement in several cases. The only decline of the week is one of $\frac{1}{32}$ in the little West India and Panama Ordinary; the company's Second Preference are ¼ harder. Quiet advances have occurred in the Anglo-American Cable group, and Globe Preference rose 7s. 6d., making 17s. 6d. in the past fortnight. The Ordinary shares also are better.

Buyers of National Telephone issues have favoured the two Debenture stocks, and the Preferred and Deferred. No change took place in the prices of the three classes of Preference shares.

After their sharp upward move, Home Railway stocks have come to a pause. There is still much talk of possible working agreements between companies other than those officially announced by the Great Northern and Great Central, but, for the time being, investment proceeds slowly. Tube stocks, like many others, are content to retain their advances of a week ago. Metropolitan Consolidated, after being dull, firmed up to 37½, though this leaves them slightly lower. Underground profit-sharing notes are called 37, and the stocks of the various companies in the Speyer group are unaffected by the latest proposals to rearrange through-bookings.

British Electric Traction shares of both kinds are harder, but an unpleasant feature is the further falling away in the Debenture stock prices. The First Debenture is down a point, and the Second shows 2½ loss, the latter becoming a more or less nominal market. Anglo-Argentine Tramways shares are being quietly absorbed, as some of us expected, by investors; the Second Preference are 5s. and the First Preference 3s. 9d. better. There has been a small demand for Calcutta Tramways First Debenture stock.

Electricity Supply shares are irregular. Westminsters gave way somewhat abruptly upon liquidation for deceased accounts. A few prior charges are a little lower. Edmundson's Preference changed hands on Monday at what appears to be the absurd price of a sovereign. City of London shares are better, and London Electric Preference rose 5s., while Hove shares eased off.

Edison & Swan £3 paid declined upon the offer of a retail number of shares, but Electric Constructions continue to advance, and the improvement extends to the Preference as well as the Ordinary. Telegraph Constructions added a further 10s. in sympathy with the firmness of the Telegraph Section, and Castner-Kellner shares rose 2s. 6d. The debenture stock has put on 3 points, the improvement in the company's position, as shown by the recent accounts, meeting with more general recognition.

India-Rubber shares rose 10s. to 15¼ upon the excellent showing made by the report just out. Canadian General Electric common shares fell 3 to 103, and Mexican Electric Lighting bonds at 77 are a point lower.

Belgium.—La Compagnie Belge d'Electricité Siemens-Schuckert, of Brussels, reports a profit of £716 for the last financial year.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Dec. 3rd.	Closing Quotations Dec. 10th.	Business done week ended Dec. 10th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2½ — 3½	2½ — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
$131,551,400	American Telephone & Telegraph, Cap. Stock ..	$100	7¼%	7¼%	7½%	8 %	.. ..	106 —109	..	..	..	7 10 11
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	.. ..	88 — 90	..	..	..	4 8 11
660,660	Anglo-American Telegraph	Stock	61s.	23%	31½%	37½%	55 — 58	55 — 58	56½	55½	..	6 13 7
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	98½—100½	99 — 101	100⅜	99½	+ ½	5 18 10
3,169,670	Do. do. do. Deferred ..	Stock	2s.	Nil	½%	1¾%	14½— 15½	14½— 15½	15 5/16	14 13/16	..	11 9 6
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6½— 7½	6½— 7½	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	83 — 87	82 — 86	85	83	—1	4 13 0
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6 — 7	6 — 7	7	..	..	7 2 10
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15 — 16	15 — 16	..	..	..	6 5 0
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3½— 3¾	3½— 3¾	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¾— 8¾	8¾— 8¾	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	8 18 2
60,710	Direct United States Cable	20	3 %	3½%	4½%	4¾%	13½— 13¾	13¾— 13¾	13⅞	13⅜	+ ⅛	6 15 7
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	128 —133	128 —133	133	130	..	5 5 3
2,000,000	Do. 3½ % Pref. Stock.	100	3½%	3½%	3½%	3½%	82 — 85	83 — 86	85	83½	+1	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	98¾—101½	98½—101¾	100⅝	100	..	3 18 10
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜— 12¾	12⅜— 12⅞	12 3/16	12⅛	..	5 8 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	100⅛	..	..	3 18 5
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 8
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98¾—100½	98¾—100½	..	..	..	3 19 7
181,127	Globe Telegraph and Trust	10	5½%	5⅝%	5½%	5⅝%	9⅝— 10⅛	9⅝— 10⅛	10⅛	9 1/16	+ ⅛	5 6 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	12⅝— 13⅛	13 — 13⅜	13 1/16	13	+ ⅛	4 10 7
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	24 %	24%	20 %	30½— 32½	30½— 32½	..	..	..	6 3 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	52 — 55	52 — 55	52	..	..	6 5 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	50 — 60	50 — 60	..	..	..	5 16 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	50 — 60	50 — 60	..	..	..	6 13 4
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅛— ⅜	1/16— 3/16	14/3	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	⅛— 1/16	⅛— 1/16	20/7½	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅝— 1	⅝— 1	..	..	..	5 6 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106½—108½	107½ -109½	109	107½	+1	5 9 7
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	104½—106½	106 —108	107½	105¾	+1½	4 12 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾— 12⅝	10¾— 12⅝	..	..	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 8 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅝	5 1/16— 5 7/16	..	..	+ 1/16	4 11 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96½— 96¾	97 — 99	98½	97½	+ ½	3 10 8
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99½—101½	100 —102	100⅝	..	+ ⅛	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¾%	6¾%	7 %	7 %	1⅝— 1¾	1 1/16— 1 3/16	21/3	..	— 1/16	5 17 11
50,000	Do. do. do. 6 % Cum. Pref.... ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..	5 1 1
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	124 —127	124 —127	..	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7⅛	..	..	..	5 12 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4⅞— 5⅛	4⅞— 5⅛	..	..	..	4 13 0
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	8 16 9
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	7 %	12⅜— 13⅛	12⅜— 13⅛	13 1/16	..	..	5 5 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	98½—101½	99½—101½	100	..	..	3 18 10
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	7/16— 9/16	7/16— 9/16	8/1½	..	— 3/32	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7 — 7½	7 — 7¼	7	..	..	10 13 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6½— 7⅛	7 — 7½	..	..	+ ⅛	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 580,097	5	..	8 %	8 %	8 %	7½— 7¾	7½— 8	7¾	7 5/16	+ ⅛	5 0 0
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	5⅝— 5¾	5⅛— 5 1/16	6	5⅝	+ 1/16	4 10 9
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	128 —131	128 —131	130	..	..	4 11 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 8
880,000	Babcock & Wilcox, 1 to 880,000..	1	17 %	20 %	20 %	20 %	3½— 3⅝	3½— 3⅝	74/4½	71/10½	..	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	3 16 10
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	8½— 4¼	8½— 4¼	76/10½	..	..	7 15 7
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4½— 5	4½— 5	99/4½	..	..	7 0 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4¼— 4⅝	4¼— 4⅝	..	..	..	6 6 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3¾— 4¼	3¾— 4¼	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	5 13 5
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	94 — 97	94 — 97	95½	95½	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	123 —128 xd	123 —128	..	..	..	4 10 3
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	104 —109 xd	104 —109	..	..	..	4 7 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	99 —103	99 —103	..	..	..	4 17 1
288,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1½— 2	1⅝— 2⅛	37/6	33/9	+ 1/8	Nil
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	4½— 5	4⅝— 5½	102/6	97/6	+ ⅜	11 8 6
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	92 — 95	91 — 94	92⅜	91⅝	—1	5 6 5
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	73 — 77	70 — 75	..	..	—2	6 0 0
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¾— 7	6⅝— 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞— 6⅛	5⅞— 6⅛	5⅛	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	⅞— 1½	⅞— 1½	..	..	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	..	..	6 3 1
50,000	‡Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	3/16— 7/16	3/16— 7/16	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	0 — ¼	0— ¼	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	⅜— ⅝	⅜— ⅝	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	6 12 4
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	65 — 68	65 — 68	..	..	..	6 8 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅜— 4⅝	4⅜— 4⅝	..	..	..	3 4 10
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4½— 5½	4½— 5½	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4½— 5½	4½— 5½	..	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
137,610	Calcutta Trams, 1 to 137,610	5	6 %	8 %	8 %	8 %	6⅜— 6⅞	6⅜— 6⅞	..	..	..	5 16 4
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	..	..	5 %	5 %	5 — 5½	5 — 5½	5 5/16	..	+1	4 5 9
850,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	100 —104	101 —105	..	..	..	4 6 7
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9½ — 10½	9½— 10½	9⅝	..	..	7 6 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5½— 6	5½— 5¾	..	..	— ⅛	4 4 3
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105¼—107¼	105¼—107¼	..	..	..	4 3 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1⅝— 1 1/16 xd	1⅝— 1⅜	26/6	25/3	+ 3/9	5 16 4
294,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	98 —102	101 —104	..	..	+2	4 6 7
911,566	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	62 — 65	62 — 65	65	63¾	..	6 3 1
544,216	Do. do. 4 % Pref. Stock †..	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	84	83¾	..	4 14 2
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	41 — 44	41 — 43	..	..	— ½	9 6 0
1,480,000	City and South London Railway	Stock	2¾%	2¾%	1¾%	2¼%	43 — 45	43 — 45	44½	..	..	4 14 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 3rd.	Closing Quotations Dec. 10th.	Business done week ended Dec. 10th, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	3	2½%	2½%	2½%	5 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	8 6 8
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1 0
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1 1/8 — 1 3/8	1 1/8 — 1 3/8	..	..	..	7 5 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1 1/4	1 — 1 1/4	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	101½	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	12½— 13½	12½— 13½	..	..	..	4 8 11
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½— 13½	12½— 13½	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1 3/16 — 1 1/8	1 1/16 — 1 1/8	..	..	+ 1/16	11 7 6
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	4½%	1½ — 2½	1½ — 2½	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	79 — 82	79 — 82	..	..	..	4 17 7
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	5/32 — 3/32	5/32 — 1/16	..	..	+ 3/32	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1/2 — 1	1/2 — 1¼	..	..	+ 1/8	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1 — 1½	1¼ — 1½	..	..	+ 1/4	15 4 10
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10¾	10½ — 10¾	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10½ — 11½	10½ — 11½	..	..	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5½	5 — 5½	..	..	..	3 17 8
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	104 —106 xd	104—106	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14½ — 15½	14½ — 15½	15½	15	+ ½	6 7 0
87,500	†Liverpool Overhead Railway, Ord.	10	1¾%	1¼%	Nil	Nil	1½ — 1¾	1¾ — 1¾	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6½ — 6¾	6½ — 6¾	..	..	..	4 8 11
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6½ — 6¾	6½ — 6¾	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7½ — 8½	7½ — 8½	..	..	..	6 1 3
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	81 — 86	82 — 86	83¼	..	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/8	1/16 — 1/8	16/8	..	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 1/8	1/16 — 1/8	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/16 — 1/4	3/16 — 1/4	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	28 — 30	28½ — 30½	29	..	+ ½	5 7 2
150,000	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	3½ — 3¾ xd	35 — 39	40	..	..	13 3 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	3/4 — 1½	3/4 — 1½	21/-	16/10½	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3½ — 3¾	3¾ — 3¾	67/6	60/-	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 75 xd	72 — 77	..	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅝— 5⅛	4⅝— 5⅛	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10 %	7 — 8	7 — 8	..	..	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..	4 7 6
886,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3⅞ — 4⅛	3⅞ — 4⅛	..	..	..	5 2 10
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅞ — 4¼	3⅞ — 4¼	..	..	..	5 5 11
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3⅞ — 4¼	3⅞ — 4¼	81/3	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	96 — 99	97 —100	..	..	+1	4 0 0
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3¾ — 4¼	3¾ — 4¼	..	..	..	5 5 11
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9½ — 10¼	9½ — 10¼	10¼	9¾	+ ¼	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅜	11 — 12	..	..	+ ¼	5 0 0
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	..	5 %	5 %	5 %	122 —125	122 —125	124	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	97½	96¾	..	4 11 10
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3½ — 4¼	3½ — 4¼	..	..	..	4 14 1
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4⅜ %	5 %	5 %	6½ — 7¼	6½ — 7¼	7	..	..	6 13 4
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 10¾	10 — 10¾	10 7/8	10 7/8	..	5 11 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	105 —108	106½	106	..	4 12 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	95 — 98	94 — 97	96	..	—1	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	3/8 — 7/8	3/8 — 7/8	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 1½	1 — 1½	20/-	..	..	8 11 5
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	75 — 80	..	..	—1	5 12 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5%	5%	4¼ — 5	4⅛ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4¼ — 5⅛	4⅛ — 5⅛	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6½ — 7	6⅝ — 6¾	..	..	— ⅛	6 10 11
21,000	Kensington and Knightsbridge Electric Ord.	5	12 %	12 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1¼ — 1½	1¼ — 1½	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	3¾ — 4¼	4 — 4½	85/-	..	+ ½	6 13 4
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 93	89 — 93	..	..	..	4 16 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8⅜%	10 %	10 %	8 %	5¼ — 5⅝	5¼ — 5⅝	5⅜	..	..	6 19 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 5	4⅜ — 5	98/9	..	..	4 10 0
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	102 —106	102 —106	104	..	..	4 4 11
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	86 — 89	87 — 92	..	..	+1½	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 99	96½ — 99½	..	..	+ ½	4 10 6
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6¼ — 6⅝	6¼ — 6⅝	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
16,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	10½ — 11½	10⅝ — 11½	..	..	..	6 10 5
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6¾%	7 %	7 %	7 %	5⅝ — 6	5⅝ — 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	96 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7¼ — 8¼	7¼ — 8½	7½	..	..	6 1 3
20,000	Do. do. 7 % Pref. 20,001 to 40,000	5	7 %	7 %	7 %	7 %	6 — 7	6 — 7	..	..	..	5 0 0
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	87 — 92	..	..	+1	3 16 1
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	⅛ — 1¼	⅛ — 1¼	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 76	71 — 75	..	..	..	5 4 4
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2 — 2⅛	2⅜ — 2⅝	50/-	48/9	+ 3/8	6 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	1/2 — 3/4	1/2 — 3/4	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 5/16 — 1 7/16	1 5/16 — 1 7/16	..	..	..	5 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	11 10 6
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1¼ — 2¼	1¼ — 2¼	..	..	..	8 13 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	92 — 95	90 — 93	..	..	—2	4 16 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	8 — 9	7⅜ — 8⅛	8¼	7⅞	— ⅛	7 1 2
61,979	Do. do. 4½ % Cum. Pref. (Origina 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4⅜ — 5⅛	4⅜ — 4⅝	95/-	92/6	— ⅛	5 2 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 7 per cent. November 7th, 1907.

THE CANAL INQUIRY.

[COMMUNICATED.]

The collecting of evidence by the Royal Commission appointed to inquire into, and report upon, the canal and inland navigations of the United Kingdom has been proceeding at a fairly rapid rate for over 18 months. The second instalment of the first volume of this evidence was placed at the disposal of the public nine months ago, and a further part may be looked for soon, the contents of which have already been made more or less public, so it is fairly possible to arrive at an idea of the trend of the evidence before the Commission, and of the character of the recommendations which will be its outcome. The second instalment of the first report of the Commission contained the minutes of the evidence of over 50 witnesses, and their replies to some 11,300 questions, and was accompanied by an excellent map of the canals and navigations of England; those of Scotland and Ireland were omitted, but, it may be hoped, will be provided in the future volume.

We have already on more than one occasion expressed views with respect to the canal question in this country, which we believe did not all agree with the opinions so often reiterated by the exponents of popular prejudices, and which most assuredly were very far removed from the views embodied in the terms of the reference submitted to the Commission. The reference seems to us to be framed clearly on the assumption that canals are useful, and benefit trade, and that, therefore, they should be improved and vested in or controlled by public bodies. Now there can be little doubt that the questions most of us would like to have authoritatively answered are none of these, but others which are precedent to them and call for answer before any of them, such as, Are any canals under the present conditions of transportation of any use? Will they be of any probable utility in the future?

Of course, the admirable collection of evidence embodied in the questions and answers for which the Commission is responsible, implicitly contains the answers to the questions we have just enunciated, albeit in a fragmentary fashion. We, however, fear that the fragments may never be collected and applied to furnish the answers we seek, because they lie outside the narrowed terms of the reference. Of the 54 witnesses whose evidence is reported in Vol. II of the "Canal Inquiry," 14 were officials connected with canals, seven were engineers, of whom six were in the employ of canal companies, six were county officials, three representatives of Chambers of Commerce, 14 were traders, coalowners, manufacturers, and carriers, seven were agriculturists and three were Government officials. The one independent engineering witness not officially connected with canal undertakings submitted evidence, as might have been expected, most unpalatable in character to those who would gladly see public money lavished in reviving a system of transportation which we cannot help thinking is to-day in most cases as obsolete as carriage by pack animals. This opinion seems, however, to be largely shared by the majority of the witnesses. It is impossible to ignore the fact, that the persistence of any special form of transportation ultimately must depend on its adaptability to the conditions imposed by the requirements of intercommunication and exchange pertaining to any given epoch and congruous to the development of any given country. Our appreciation of its suitability to the conditions of the work to be performed is the basis of the estimate we individually frame of the relative convenience of various methods of transportation. We instinctively prefer what is more convenient, because it is easier by its means to perform a given work, or, in other words, because it enables us to follow the path of least resistance and achieve our object with the minimum expenditure of effort in labour and money.

To be suitable to the requirements of intercommunication in our islands at the present day, and to merit the epithet convenient, any form of transportation must fulfil in an appreciable and improving measure the following at least among many essential and necessary conditions: It must be readily accessible to all those requiring transportation, it must involve a minimum of handling and transhipment, and it must possess the elements of reasonable despatch. An ideal system of transportation would be one which should enable passengers and goods to enter or be placed on the vehicles used for their transportation at the place where they dwelt or at the place of production respectively, and to travel in these vehicles as quickly as possible without changing or being touched, as the case might be, till they reached their destination. This, in the case of goods, would be the locality of distribution to the consumer. The preceding conditions should apply irrespective of the distance and the relative situations of the points of departure and arrival. In the first place, it is evident that no system of transportation using the surface of either water or earth could ever be an ideal system for all cases, and secondly, that the universally ideal system, so far as this globe is concerned, could only be one solely using the atmosphere.

In most point-to-point journeys a change of carriage from land to water, or *vice-versâ*, must be sooner or later unavoidable in order to complete any desired journey. Such a change may invariably be assumed to involve variety both of vehicle and of method of transportation, with incidental handling of a more or less costly and retarding character. Although we are very possibly within measurable distance of the practical solution of the main difficulties besetting the problem of aviation, we are probably very far removed from the period when either goods or passengers will be able to be transported at reasonable cost and in adequate amounts through the atmosphere, so that it would serve no practical purpose to do more than allude to the ideal merits of this system of transportation that will eventually, no doubt, be placed at our disposal. The more practical questions of the merits and deficiencies of canal transportation, as revealed in the evidence before the Canal Commission, will furnish more profitable matter for consideration.

It is more and more evident that neither passengers nor goods can be called upon to seek transportation at any unreasonable distance with impunity, either to the earning capacity of the system itself or to the development of the traffic for whose benefit it exists. Where the deficiency in accessibility cannot be remedied by the substitution of other means of transportation offering superior facilities, then the inevitable result is that the traffic will dwindle, and eventually cease, either by actual extinction or by a transference to more suitably situated localities. On the other hand, it will never be possible to attract traffic away from centres where facilities are abundant to others where they are scarce, or to transfer patronage from means of transportation offering sufficient facilities to others offering none. Luckily the question of passenger traffic does not enter into the consideration of the utility or the reverse of canals, as here the critical condition of rapidity of transportation has long been recognised as essential. Canal transportation is concerned solely with the question of goods, and almost exclusively with the question of slow, as distinguished from express, goods. Canals, to be of unquestionable utility to our manufacturing, distributing and exporting communities, must, therefore, enter into direct competition with the best paying elements of railway transportation. To enter into this competition with any prospect of success, canals must, consequently, offer at least as reasonable facilities as the railways. They must be at least as accessible to the manufacturer and the consumer, they must be able to offer at least equal facilities for handling goods where they are received and where they are delivered, and they must be able to take charge of them in as large quantities and deliver them with approximately as expeditious despatch. Otherwise the small possible advantage canals may be able to offer in respect of charges will not be able to compensate for their other deficiencies. In this connection it should not be forgotten that one of the most unmistakable and growing features of modern export trade in our islands is the doing away with the export warehouse at the shipping ports, and the substitution therefor of the warehouse at the works themselves, supplemented by the accelerated delivery of the goods in complete train-loads at the ship's side, by trains practically disgorging their freight directly into the holds of the ships.

This practice obviously involves the element of accelerated delivery, and necessitates the handling of goods in increasingly large quantities. It also involves the placing of the

works themselves in direct communication with the railways by means of extensive private sidings, and the discouragement of all cartage operations, not only on the ground of increased cost, but on account of loss of time.

Had the existence of railways never brought about the displacement of works from the older centres of production, and had they not determined the situation of new works and new centres of production, as they undoubtedly have done, without any effective opposition, or, indeed, often without any opposition at all, on the part of the more ancient canal systems, then it would have been conceivable that by improvements in the methods of canal carriage and in the canals themselves they might still have advantageously dealt with the traffic they ought to receive on equal terms with the railways. It might also have been conceivable that the vast sums required to improve them to the requisite degree would be money well spent. But handicapped as they are by the antiquated details of their design, which rendered them at best only adequate to the conditions of transport demanded by the trade of over a century ago; handicapped by the creation of railway facilities which have kept fairly abreast of the requirements of the present altered conditions of trade, and which have been evolved in the last 60 years, and are still in the evolutionary stage; handicapped by the migration of the works and of the centres of production themselves; handicapped by popular prejudice, which originated in the falsification of too sanguine financial anticipations of the past, and has been perpetuated by the knowledge of their increasing inefficiency; and, finally, handicapped by the cost and difficulty of remodelling them on efficient modern lines; we may well ask what reasonable chance can canals possess of rehabilitation? The geographical conditions themselves of the British Isles, pointed out by many of the witnesses, have constituted another serious disability under which inland water carriage of the ordinary canal type must always labour; the proximity of our manufacturing centres to the coast (average distance under 80 miles), the great extent of coast line in proportion to area of the land, and the profusion of harbours, all these in combination render any possible advantage in freights offered by the canals over railways too small a quantity seriously to outweigh the disabilities they would possess in other respects.

To place our canal system, or those portions of it which might be of serious utility, that is, the main through routes or trunk lines connecting the chief manufacturing centres among themselves and with their natural outlets in the coast line (totalling some 687 miles) in a condition of reasonable equality with existing competing railways, it would be necessary (according to the evidence of a competent and moderate witness) to improve 30 per cent. at a cost of £30,000 a mile, and 35 per cent. at a cost of £15,000 a mile, and to equip with improved services the 35 per cent. remaining. This conservative estimate would involve an expenditure of £10,205,000 for reconstruction alone. If these proposals were extended to the six principal groups of canals comprised in the English system (some 2,818 miles), that is, the Lancashire and Yorkshire, the Cheshire, Montgomeryshire and Stafford, the Gloucester, the Worcester and Warwickshire, the Thames and Severn, the Lincolnshire, Derby, Nottingham and Leicester, and the Cambridgeshire, Norfolk and Suffolk systems, the expenditure would be as nearly as possible quadrupled, reaching in round numbers some 41 million pounds. The cost of expropriating the canals themselves at the rate of 25 years' purchase of the net profits, would be some £12,500,000, but would most likely be double that sum in accordance with general precedent in the matter of public appropriations.

The very least that the moderate estimate above alluded to, which does not deal with more than two-thirds of the canals actually existing in England and Wales alone, may safely be put down at is 60 millions; that is, each rehabilitated canal would cost over £21,000 a mile. This rehabilitation, however, would not mean that they would be converted into up-to-date waterways provided with the conveniences, and especially the tractive appliances, without which no canals can be considered up to date, and certainly would not place them in the condition which alone could warrant their ownership by the State.

The experience gained with the ancient "fly boats," and the investigations carried out by Scott-Russell on the laws of wave propagation under canal conditions, have probably been forgotten by the majority of our readers, so we need not apologise for referring to them, more especially since they should play an essential part in the rehabilitation, if it ever be decided upon, of our waterways. The facts established by the above investigations were somewhat as follows:—

Long waves when propagated in a canal travel with a speed depending on the depth of the canal. That is, where the wave length is large compared with the depth of the canal, the speed of propagation is equal to the velocity acquired by a body in falling through half that depth—the deeper the water, the quicker the wave can travel.

Mr. Scott-Russell in 1834 carried out some careful experiments on the motion of canal boats, which were communicated to the Royal Society of Edinburgh. From these he deduced that it is only when the speed of a canal boat is less than the velocity of a long wave in the canal that it leaves behind it, or is followed by, a procession of waves. The position of the boat is then on the rearward side of the first wave, and it leaves behind it a trail of waves, the rearward limit of which travels forward at half the speed of the boat. If the speed of the boat is greater than that of the longest possible free wave in the canal, it cannot make any procession of waves and no system of progressively lengthening waves behind it can be set up, but only one wave or hummock travelling along under the boat. Lord Kelvin in Vol. III of his Popular Lectures, when dealing with the question of ship waves and navigation, states that the discovery of the above remarkable fact was due to a horse belonging to William Houston, employed in towing canal boats on the Glasgow and Ardrossan Canal. On one occasion this horse took fright and galloped off, and Houston, who was an observant man, noticed that when once the horse had attained a certain speed the exertion required for towing the boat became lessened, and that it was dragged along more easily and without *wash* behind it. Houston accordingly started a service of light canal boats —or fly boats, as they were then called—about 60 ft. long, and drawn by two horses at 7, 8 and 9 miles an hour. The horse when galloping along speedily dragged these boats up to the top of their own wave, when they proceeded more easily and without a system of following waves. Mr. Scott-Russell's investigations were made in 1837 on the Forth and Clyde Canal near the Hermiston Bridge, where there was a straight run of 1,500 ft. The depth of water there was from 4 to 5 ft., and the corresponding speed of the long wave was about 72 ft. per second, or 8 miles an hour. A boat weighing some 5 tons, called the *Raith*, was used, and was towed at various speeds, the tractive effort being measured by a dynamometer. As will be seen by the accompanying table, the tractive effort fell off in a marked degree after the speed of 9 miles was reached. Similar results were obtained with another boat weighing 6 tons:—

	Effort in lb.	Speed in miles.		Effort in lb.	Speed in miles.
5 tons	112	4·72	6 tons	250	6·19
	261	5·92		500	7·59
	275	6·19		400	8·52
	250	9·04		280	9·04
	269	10·48			

The proofs thus given by Mr. Scott-Russell, that the tractive force exercised undergoes a sudden diminution when the speed of a canal boat approximates to, or first exceeds, that of the long wave corresponding to the depth of the water in the canal, are conclusive. As Prof. Fleming, in his lectures upon Waves and Ripples, very justly observed, "If passenger traffic on canals had not been destroyed by the advent of railways, we should, no doubt, have seen extensive applications of the principle discovered so curiously by the aid of an alarmed horse, and so skilfully investigated by a celebrated engineer."

The most interesting point, however, in the above discovery is not so much that the tractive effort becomes a minimum when the speed of a boat towed along a canal reaches the velocity of the long wave corresponding to the depth of water therein, but the fact that at, and above, this speed the boat is no longer followed by any trail of waves or wash. For this discovery renders it possible to do away with the chief difficulty and chief source of expense in the maintenance of canals when accelerated traction is adopted,

and, therefore, with the only objection to working canal traffic at reasonable speeds. The laws of wave propagation, however, also indicate that to do away with the destructive wash which so disastrously affects canal banks, it is not only necessary to conduct the traffic at speeds exceeding that of the long wave in the particular canal in question, but that the tractive effect must be applied by towing from the bank and not by means of tugs, or screw or paddle propulsion on the barges themselves, as the lateral trains of waves set up by the propellers cannot be eliminated by augmenting the speed, and the serious mischief to canal banks would still continue unabated.

(To be continued.)

PROCEEDINGS OF INSTITUTIONS.

The Development of Turbo-Generators.

By Dr. Robert Pohl, Associate Member.

(Abstract of Paper read before the Institution of Electrical Engineers, *November 29th*, 1907.)

The present paper is confined to d.c. generators, and deals with these mainly from the point of view of their electro-magnetic design, in which the greatest obstacles to further improvement are encountered. The object is to show why certain outputs and speeds cannot at the present time be safely exceeded, to define these output limits, and to discuss briefly the directions in which further improvements may be expected.

In view of the desirability—from the turbine maker's point of view—of running the set with as high a speed as possible, we have first of all to answer the questions: Given a certain diameter of the armature, what will be the maximum permissible speed at which it may be run, without undue stress being set up? and secondly, what is the maximum possible output thereby obtainable, assuming the armature to be made axially as long as possible? In finding the reply to these questions, we shall arrive at a curve showing the highest possible speed for which a generator can be built as a function of its output.

In slow speed machines the output, as is well known, is limited either by the sparking or by the heating. For the purpose of our present investigation, as may be particularly noted, we shall leave the question of temperature rise altogether out of consideration, because, though it requires the most careful attention in design and construction, it cannot be considered as an output limit. The extremely high periodicity and consequent large iron losses with which most turbo-generators have to work, coupled with their small dimensions, necessitate in most cases the employment of artificial cooling devices. A number of systems for artificial ventilation, which allow of the regulation of the quantity of air forced through, are in use, so that the heating limit can, for our purposes, be considered as lying above the output limit as fixed by other considerations.

The mechanical or speed limit of an armature is defined by the circumferential velocity, for which the tensile stresses reach their permissible limit. In working through modern turbo-generator designs it will be found that it is invariably the stress in the end shells protecting the connections which first approaches the limiting values. If we calculate the stress occurring in an ordinary unloaded ring, of radius r cm., thickness δ cm., and specific weight γ, rotating with velocity v m./sec., we obtain for the highest permissible velocity—

$$v_{perm.} = 10 \sqrt{K_{perm.} / \gamma} \text{ m./sec.}$$

where $K_{perm.}$ is the maximum stress permissible.

Allowing a permissible stress for ordinary bronze castings of 260 kilogrammes per sq. centimetre (tenacity about 1,500), we obtain as maximum velocity for an unloaded ring 55 m./sec. Considering the additional load due to the end connections, the maximum speed will only be about 50 m./sec. In order to allow of higher circumferential velocities, special phosphor-bronze and manganese-bronze castings are generally employed for the end shells. As the permissible stress for these materials is about 600 kilogrammes per square centimetre or even higher (tenacity about 3,500 to 4,500), the maximum velocity will be found to be 75 to 85 m./sec. under the conditions of load prevailing in such machines. If, for the purpose of our consideration, we assume 75 m./sec. to be the maximum circumferential velocity, we arrive immediately at the highest possible speed in revolutions per minute for any armature of given diameter.

While in ordinary slow-speed d.c. machinery the only electrical limit is that of sparking, in high-speed machines we have not only to deal with this factor but also with a new one, which we may term the "flash-over limit," and which requires quite as much attention as the commutation. Not a few turbo-generators, in spite of their good commutating qualities, have proved to be failures on account of their tendency to arc round the whole commutator. In not a few cases the trouble must be attributed to the excessive potential difference between two adjacent commutator bars.

The circumferential velocity is already fixed as not more than 75 m./sec., and in limiting the voltage per segment, the highest number of lines of force which can be allowed to pass through the gap per centimetre of armature circumference is at the same time settled. In other words, by limiting $e_{seg.\ max.}$ the product $B_{g\ max.} \times I_a$ is simultaneously limited, which practically means also the length of the armature.

Experience has shown that slow-speed machines, with clean commutator and the usual thickness of mica insulation between the segments, approach their flash-over limit if the voltage per segment reaches a maximum of about 60 volts. As a safe limit in the case of turbo-generators 40 volts may be taken, the smaller figure taking into account the effect of load fluctuations, dust, &c. In testing and examining a large number of different machines the author found this figure only once or twice slightly exceeded. From $e_{seg.\ max.} = 40$ volts, and $v = 75$ m./sec., the product $B_{g\ max.} \times I_a$ is found to be—

$$B_{g\ max.} \times I_a = \frac{40 \times 10^8}{2 \times 75 \times 100} = 267{,}000.*$$

Assuming 25 per cent. field distortion ($B_{g\ max.}/B_{g\ mean} = 1{\cdot}25$), then $B_{g\ mean} \times I_a = 215{,}000$, which for $B_{g\ mean} = 5{,}000$ corresponds to $I_a = 43$ cm. as greatest permissible length of the armature, independent of its diameter. We now arrive at the total number of lines $p \times N$ (p = number of poles, N = flux per pole), entering or leaving the armature. Taking the ratio pole-arc : pole-pitch = $a = 0{\cdot}65$,† we find $p N = d_a \pi a B_{g\ mean} l_a = 0{\cdot}44\ d_a\ 10^6$ (second column of Table I). It will thus be seen that in the design of the magnetic circuit of a turbo-generator the flash-over limit is of the utmost importance, as it restricts the number of lines allowed to enter or leave an armature of given diameter.

Commutation Limit.—The only point which now remains to be settled, before arriving at the highest output, is the question as to how many ampere-turns can be accommodated on the circumference of the armature, or, in other words, what is the highest permissible specific load A_S (ampere conductors per centimetre of armature circumference). The limiting factor in this case is the sparking. For 550-volt machines A_S may be considerably higher than for 240 or even 120-volt machines. Although a general fixing of A_S values is therefore impossible, the accompanying curve, fig. 1 (p. 991), applicable to well-designed 550-volt machines working with the above-stated values of v and I_a, may be adopted as containing the limiting figures. Having thus settled upon the values of A_S, $p \times N$, and the speed, the maximum possible output in kilowatts for any assumed diameter can now easily be deduced.

As the E.M.F. produced by a generator is $E = p N \times \frac{s}{a} \times \frac{n}{60} \times 10^{-8}$,

and the current strength $C = A_S \times d_a \pi \times \frac{a}{s}$,

the output will be KW. $= \frac{E \times C}{1{,}000} = p N \times A_S \times d_a \pi \frac{n}{60} \times 10^{-11}$.

The following table, based on the above calculation, shows the maximum outputs and speeds which at the present time are obtainable in the very best designs:—

TABLE I.

d_a in centimetres.	N for $v = 75$ m./sec.	$p N \times 10^{-6}$.	A_S.	Output in kilowatts.
30	4,780	13·1	150	148
40	3,590	17·6	185	244
50	2,870	22·0	210	347
60	2,390	26·3	230	454
80	1,800	35·1	255	670
100	1,435	44·0	270	890
120	1,195	52·9	280	1,110
140	1,020	61·5	290	1,340
160	895	70·2	300	1.585
200	720	88·0	315	2,080

In fig. 2 the output figures are plotted as function of the speed, and the curve of the Parsons turbine, as usually constructed, is indicated by a dotted line. The comparison shows that up to about 500 KW., the dynamo can be built to the requirements, whilst for outputs above 500 KW., the proper domain of the steam turbine, it is not possible to construct d.c. generators running at so high a speed as the equivalent turbine demands.

There are two ways of overcoming the discrepancy. The one consists in artificially reducing the speed of the steam turbine, which, however, is connected with increased cost and steam consumption; the second is the tandem arrangement of two dynamos coupled to one turbine, the capacity of each being half the turbine output.

Both methods can only be considered as temporary measures. Considering further the growing demand for large units, the endeavour of all manufacturers of turbo-generators to extend the output limits appears to be fully justified.

In 1904 the publication of the test results and of the construc-

* The armature winding is assumed throughout the paper to be an ordinary lap winding, for which the P.D. between two adjacent commutator bars is equal to the E.M.F. induced in two conductors in series.

† For reasons of leakage and core density a is usually much smaller than in ordinary machines.

tion of a 300-kw. homopolar turbo-dynamo, built by the General Electric Co., U.S.A., directed universal interest to the same. Since that time, however, so far as the author is aware, no further experimental results of homopolar machines have been published, although the patent records indicate considerable activity in that direction.

The main and somewhat threadbare objection cited against the homopolar principle is the difficulty of obtaining sufficiently high voltages. The author ventures to suggest, however, that this is not the most important one, but that the excessive weight of active material which these machines require, is, from a commercial point of view, practically prohibitive.

For v = 100 m./sec., for instance, a 1,000-kw. generator could be built for 600 volts, obtained by means of twice six slip-rings connected in series. The speed of 1,900 r.p.m. would be quite convenient. The weight of steel, however, is not less than 51 tons as compared with approximately 5 tons magnetic material for a commutating machine of similar output. This comparison will suffice to show that at present it is out of the question to commercially obtain satisfactory results with homopolar machines. At the same time the fact must not be lost sight of that the 12 slip-rings for 1,670 amperes each, which are not easily accessible and rotating at

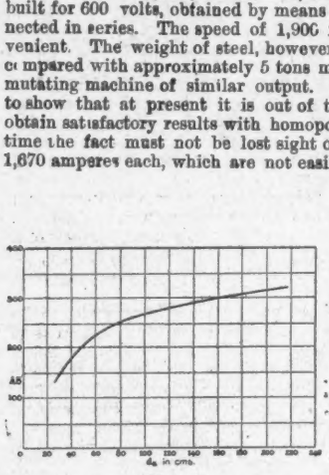


Fig. 1.

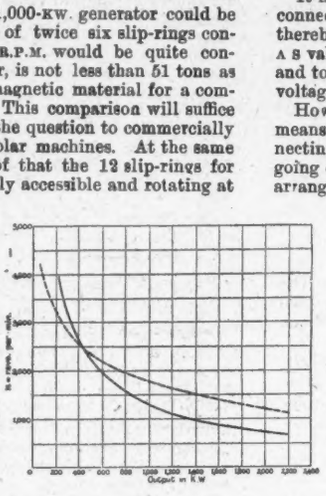


Fig. 2.

Fig. 3.

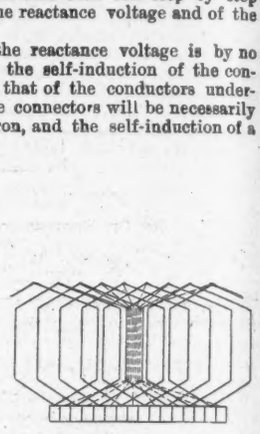


Fig. 4.

very high speed, will most likely require as much attention as a turbo-commutator. The extraordinary increase in steel weight as compared with the steel required for commutating machines cannot by any means be compensated for by a slight saving in copper which may possibly be effected.

Means for the Improvement and Increase of Output of Commutating Machines.—Such means must have for their object the further extension of the above discussed two limits, namely, the sparking and the flash-over limit. This can be accomplished, first, by working with a higher circumferential velocity of the armature. Considering two machines of equal output and speed, of which the one has the armature diameter D, the other the diameter 2 D, the length of the armature of the second will be only a quarter of that of the first, whilst for the same pressure the number of conductors and segments will be doubled. The voltage per segment, and approximately also the reactance voltage, will therefore only be one-half of the respective values of the first machine. These two voltages may be taken as being approximately inversely proportional to the circumferential velocity employed. Now 75 m./sec. cannot very well be exceeded with ordinary manganese-bronze or phosphor-bronze castings for the end shields. By employing, however, certain steel alloys of very low magnetic conductivity and high tensile strength, further progress in this direction appears to be possible. The difficulties connected with balancing, which rapidly increase with increase of circumferential velocity, must, however, not be disregarded.

A further possibility seems to lie in the careful adjustment of the commutating field. This would have for its object the extension of the A S line without exceeding the sparking limit. As is well known, in machines with artifical commutation additional short-circuit currents and sparking can only occur if the E.M.F. induced by the commutating field is different from the reactance voltage. Now as the latter increases exactly in proportion to the armature current, the characteristic of the commutating field should be exactly a straight line. Unfortunately this is not the case, and, in fact, it is mainly the deviation from this straight line which ultimately causes sparking and limits the permissible A S. Even for the very low saturations obtaining in the commutating poles of turbo-generators the characteristic of the commutating field is slightly convex instead of being exactly straight.

The author has found that the following methods allows an adjustment of the form of the characteristic. A shunt parallel to the commutating poles is employed, the resistance of which increases rapidly with increasing load. Iron resistances of the kind used for Nernst lamps are particularly suitable, although thin copper wires may also be employed, for which without enclosure in an air-tight bulb high temperatures may be permitted. As will easily be seen, the ampere-turns of the commutating poles as a function of the load will now rise according to a concave curve, thus compensating for the curvature of the characteristic. Experiments have shown that almost exact straight line relationship between the intensity of the commutating field and the load is thus obtainable within very wide limits.

Coming finally to the flash-over limit, the possibility might be suggested of improving the commutator construction with the view of preventing flashing over. This would permit of a higher voltage per segment, and would enable us to work with a larger magnetic flux and thus to increase the output. It must not be forgotten, however, that even if this were possible, an increase of the output by means of larger flux is, in principle, connected with a lengthening of the armature, and means therefore at the same time an increase of the reactance voltage and of the commutation difficulties. Thus what might be gained in flux would at least partly be lost in A S.

There is no likelihood of decided improvements in the direction of increased flux unless means are found which would enable the armature to be lengthened without exceeding the flash-over limit and simultaneously without increasing the reactance voltage. This can only be accomplished, it seems, by a suitable armature winding, and the author believes that it is in this direction that important developments must be looked for.

It has been repeatedly proposed to adopt additional segments connected to suitable points of the armature coils, and to increase thereby the number of bars without increasing at the same time the A S value. The intention is to commutate each coil step by step and to obtain a reduction of both the reactance voltage and of the voltage per segment (fig. 3).

However, it will be found that the reactance voltage is by no means necessarily reduced, because the self-induction of the connecting wires always adds itself to that of the conductors undergoing commutation. In practice the connectors will be necessarily arranged in holes in the armature iron, and the self-induction of a connecting wire will most likely be far higher than that of a conductor. There is a simple way for the neutralisation of their self-induction. If they are arranged in groups in such a way as to have connectors of opposite polarity always in close proximity to each other, so that the number of ampere conductors in every one of these groups is always zero, practically no lines of force will then be interlinked with any such group. Their self-induction is thus eliminated. Fig. 4 will make the arrangement clear. Satisfactory running machines of twice the present armature length, and of twice the output at present obtainable, appear to be within the possibilities of this winding.

Discussion.

The discussion was opened by Mr. Gerald Stoney (C. A. Parsons and Co.) who criticised as too high the author's flash-over limit for slow-speed machines (60 volts per segment); he considered that the safe limit suggested of 40 volts was, on the other hand, too low for turbo-generators, as by thickening up the mica insulation of the commutator his firm had obtained satisfactory commutation at 49 volts per segment, and the tendency was to increase this. His firm also adopted higher A S values than those suggested by the author; they had never yet had a flash-over in a modern 2-pole machine, and found these no more expensive to construct in large sizes than multipolar machines. As to sizes, his firm had built several 750-kw. and 1,000-kw. D.C. machines, and were prepared to go up to 1,500 kw. capacity if required, but future developments rested between the turbine and dynamo makers on the question of speeds. He believed the homopolar type of machine to be practically useless in this connection, judging from his firm's experiments; while Dr. Pohl's winding was very interesting, he thought that constructively it presented practical difficulties.

Mr. E. J. Fox (Willans & Robinson) suggested that the lack of satisfactory D.C. generators was hindering turbine development in this country. He advocated carbon brushes as essential to this class of machine, and deprecated the tendency to increase speed, which, while it cheapened first cost, gave unsatisfactory results.

Mr. Miles Walker (Westinghouse Co.) emphasised the necessity of carbon brushes and commutating poles from the user's point of view; he considered that 20 volts per segment was nearer the safe limit for flash-over, although it meant more expensive design. He suggested an alternate winding to that proposed by the author with a view to lengthening the armature, with satisfactory results.

Prof. S. P. Thompson remarked that the author had demonstrated that sparking even more than heating affected the output of a turbo-generator. The commutating type of turbo-generator was only possible with comparatively high voltages, but the homopolar machine was exactly the thing for low voltages. He cited a machine of this class, made several years ago by Mr. C. E. L. Brown, giving 5,000 amperes at 10 volts, and running at 1,200 r.p.m. He asked whether an arrangement of staggered brushes adopted on some Continental machines was effective in stopping flashing-over, and suggested the possibility of silver commutators to reduce frictional losses.

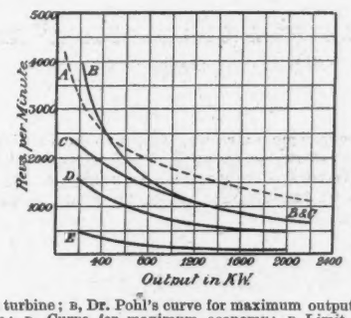
Mr. A. C. Eborall outlined the features of the well-known Brown, Boveri D C. turbo-generator, laying stress on the necessity of obtaining sound mechanical construction, especially to prevent

deformation of the commutator and loss of balance in the armature. The machine temperature should be even, with no specially hot places—a condition obtained with forced ventilation. His firm used combination metallic and carbon brushes, the metal collecting the current and the carbon having a lubricating effect. He believed in the use of a direct-coupled exciter in all cases, and pointed out that Messrs. Brown, Boveri had D.C. units of 1,200 and 1,500 KW. running.

Prof. KAPP pointed out that commutating poles would not enable a D.C. turbo-generator to meet both tramway and lighting conditions; such a machine would work within limits, but not on heavy overloads. Another way of overcoming the commutating difficulty was the Parsons compensating winding, which utilised what was really an air pole, and would extend the author's limits by a considerable extent.

MR. S. EVERSHED (?) pointed out that the frictional coefficients of copper and carbon and silver and carbon were almost the same, but the silver sulphide tarnish formed was not an insulator.

MR. A. G. ELLIS said this paper emphasised the fact that high speeds were not desirable for the driving of continuous-current machines. The many difficulties referred to in the paper showed that the additional devices for which provision must be made tended to complicate rather than simplify the construction, and increased the cost of manufacture. The turbine speed did not correspond to the most economical design consistent with good operating quality for a given output. The most economical designs were obtained at speeds considerably lower than the steam turbine speeds. In the diagram the curve D was a representative curve for the speeds corresponding to the most economical designs consistent with good quality. This curve was based on the general results obtained from a large number of preliminary designs. Curve B was reproduced from fig. 2 in the paper, which represented the author's figures



A, Parsons turbine; B, Dr. Pohl's curve for maximum output; C, Curtis turbine; D, Curve for maximum economy; E, Limit for normal designs (without auxiliary commutating devices).

CURVES FOR SPEED AND OUTPUT OF STEAM TURBINES AND CONTINUOUS-CURRENT GENERATORS.

for the maximum output and speeds. Curve D was considerably lower than curve B, which indicated that although designs could be carried out for speeds as high as those given by curve B, those designs were *not* the most satisfactory, and did *not* correspond to maximum economy. Curve A was the curve for the Parsons turbine speeds and curve C for the Curtis turbine. It was interesting to note that the author's curve practically coincided with the Curtis turbine speed curve. Hence the Curtis turbine would appear to be more suitable for continuous-current machines than the Parsons turbine. Curve E indicated roughly the limiting speeds for which continuous-current machines could be designed with such commutation constants that no recourse was needed to auxiliary poles or special commutating devices. Beyond the speed indicated by this curve the cost of a machine for a given output decreased on account of the increased speed, until the speed on curve D was reached. Beyond curve D the cost increased on account of the expense of the auxiliary commutating devices and the excessive labour costs. Although D.C. machines were not inherently high-speed machines, yet there was a tendency to even higher speeds on account of the increased economy of the steam turbine and of the generating set. Forced draught ventilation had led to a much finer degree of sub-division of the parts of the machine to enable the air to circulate freely throughout the interior, and resulted in more even temperature throughout the machine. The thorough ventilation gave a greater degree of safety from breakdown of the insulation due to local overheating; and it was worth considering whether a higher standard of temperature rise might not gradually come to be permissible in such machines on this account. He asked the author why the homopolar machines required so much as ten times as much steel as an ordinary machine. On p. 9 the author stated that "The poor utilisation of materials is mainly due to the low AS (ampere conductors per centimetre) values," but it would be interesting if he would explain why these values must necessarily be so low. In connection with this question of weight, it was of interest to quote a paragraph from Noeggerath's paper on "Acyclic Dynamos" in the A.I.E.E. *Proceedings*.* Noeggerath said, "While the total weights of both types are about equal even for moderate turbine speeds, the very low copper weight, simple construction—less labour and smaller total cost—combined with elimination of the commutating problems, should speak favourably for the new type."

As regarded the special armature windings on pp. 12 and 13, the Punga winding * would reduce the voltage between segments to one-half or one-third, according to the multiplicity.

MR. VAL. FYNN suggested as regarded the author's special winding that the reactance voltage would be four times (not twice) as great as with an ordinary winding, the voltage between segments being halved. He thought the author's connectors would be better in the armature slots than as suggested.

DR. R. POHL, in briefly replying, said he considered that multipolar machines were generally better than two-pole machines for mechanical reasons; he judged from the discussion that a 40-volt safe limit was a good average. He had never had any trouble with commutating-pole machines as regards commutation, and thought that the Parsons compensating winding, also the Deri winding of Brown, Boveri were expensive, although satisfactory in work, and that it was possible to obtain good results in a cheaper way.

The Silver Voltameter.

(*Abstract of Paper communicated to the* ROYAL SOCIETY *by* R. T. GLAZEBROOK, F.R.S., *November 21st*, 1907.)

(From the National Physical Laboratory.)

PART I.—*On a Comparison of many Forms of Silver Voltameters.* By F. E. SMITH; *and a Determination of the Electro-chemical Equivalent of Silver.* By F. E. SMITH and T. MATHER, F.R.S.

IT has been known for several years that the measurement of electric quantity by the deposition of silver is liable to inaccuracies which appear to be dependent on the size and nature of the anode and cathode, and on the electrolyte of the voltameter employed. Hence the necessity of an inquiry to ascertain the possibility of specifying a voltameter which is easily reproducible, and in which an ampere-second always deposits the same mass of silver.

In some very early experiments it was found that the mass of the deposit was dependent on the mode of preparation of the silver nitrate, but on several crystallisations of the salt constant results were obtained.

Very large voltameters were experimented with. Four of the cathode bowls had a capacity of 500 c.c. each, and in general from 300 to 400 c.c. of electrolyte were employed. The anodes were coated with electrically-deposited silver.

With a Rayleigh form of voltameter containing an electrolyte of pure silver nitrate, 52 determinations of the electro-chemical equivalent were made, the current being indirectly measured by the British Association (Ayrton Jones) ampere balance. The mean of the 52 determinations was 1·11827 milligrammes per coulomb, and the mean difference was 2·4 parts in 100,000. With a Richards form of voltameter, in which the anode liquid was separated from the cathode liquid by a porous pot, variable results were at first obtained, but this was found to be due to the presence of acid in the pots. When the pots were baked in an electric furnace before their employment in a voltameter, constant values resulted, and the mean of these was 1·11828 milligrammes per coulomb, *i.e.*, practically identical with that obtained with the Rayleigh form. Richards originally obtained a difference of 8 parts in 10,000 between the two forms, his form giving the smaller deposit; later he found the difference to be 4 parts in 10,000, and recently van Dijk has found a difference of half this latter amount. Further observations were made with a siphon and other modified forms of voltameter, and the same value, 1·11827, was found, pointing to little or no irregularity in the large-size Rayleigh form of voltameter. Deposits were made when the voltameter was subject to a gaseous pressure of 2·4 cm. of mercury, and were found to be identical with those made under a pressure of 1 atmosphere. We have thus failed to confirm the observations of Schuster and Crossley and of Kahle. At a temperature of 90° C. we found the deposits to be very slightly heavier than at 15° C., but the calculated temperature coefficient was so small (1×10^{-6}) that we believe the increase to be due to the action of the filter paper on the silver nitrate, as originally suggested by Kahle.

The range in the current intensities was from 0·5 ampere to 8 amperes, and for this range we found no appreciable irregularity.

We conclude that the Rayleigh form of voltameter as employed by us is reproducible to one or two parts in 100,000, and that the electro-chemical equivalent of silver is 1·11827 milligrammes per coulomb.

PART II.—*The Chemistry of the Silver Voltameter.* By F. E. SMITH, A.R.C.Sc., and T. M. LOWRY, D.Sc.

Before a definite value could be assigned to the electro-chemical equivalent of silver it was necessary to demonstrate the possibility of preparing again and again, from silver nitrate of different origins, solutions which should give identical weights of silver when electrolysed under identical conditions. We prepared silver nitrate from electrolytic silver, from much used silver nitrate, and from commercial samples of the salt, and satisfied ourselves that by taking precautions in re-crystallising, &c., a sufficiently constant product could be obtained. Tests on commercial silver nitrate were gratifying in so far that with one exception all the samples (eight in all) examined gave figures agreeing with those obtained from the samples which were specially prepared, and we conclude that, except in measurements of high precision, the commercial salt may be used without purifying.

Attempts to confirm the observations of Novak, Rodger and Watson, Kahle, van Dijk and others, on the effect of repeated elec-

* *Proceedings* A.I.E.E., Vol. XXIV., p. 18.

* *Journal* I.E.E., Vol. XXXIX., p. 600.

trolysis of a solution, show that in our voltameters there may be a very small increase in the deposit with continued use of a solution, but nothing comparable with that obtained by the observers mentioned. We also fail to confirm the formation, at the anode, of a complex silver salt, giving rise to heavy deposits at the cathode, as suggested by Rodger and Watson and by Richards.

High values are obtained for the electro-chemical equivalent if the solution contains oxide, carbonate, chloride, nitrite or hyponitrite. Low values are caused by acid. The impurities which raise the electro-chemical equivalent appear to be those which are insoluble in water but soluble in silver nitrate solutions; they are, therefore, precipitated from the impoverished solution at the cathode.

There may be slight changes in the electrolyte due to its interaction with filter paper, but the mass of the deposit is not seriously affected thereby in our size of voltameter in the course of one electrolysis. It is inadvisable, however, in measurements of high precision to use an electrolyte more than once.

Silver chlorate and silver perchlorate appear to give normal deposits, but are more troublesome in use and have no advantage over the nitrate.

LABORATORY TESTS OF HEAT INSULATORS.

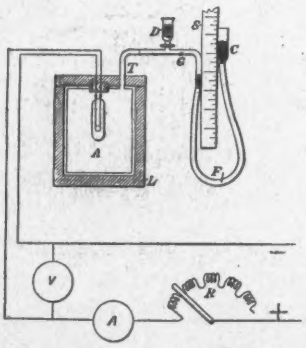
Mr. Chas. R. Darling contributes to *Engineering* an article on the above subject of some interest. Premising that ordinary tests are cumbersome when made in full-sized pipes heated by steam or by electricity, he admits that they may give accurate results, but at too great a cost.

Thus, at the National Physical Laboratory, tests of covered steam pipes 4 in. and 6 in. in diameter have been made with various thicknesses of covering. All this involves a boiler, steam pipes, traps and a good deal of labour, and even then the results may be doubtful without superheating.

Certain tests have been made in which the electrical method of generating heat inside a pipe has been employed. Presumably heat is heat, and however it is generated, an equal amount will escape through pipe and lagging in a given time; assuming this to be so, the electrical method seems to be the best to employ in a small laboratory test. In such tests as had been previously made, heat was generated by means of a current of electricity through "Eureka" wire resistances inside the pipe, and the heat being regulated to some desired steam temperature, the loss was measured by an ammeter in circuit, with a voltmeter across the terminals, when $V \times A \times 0{\cdot}057 =$ B.Th.U. per minute.

But the author doubts the accuracy of the temperature readings in this method, and in his new laboratory test he employs an air-tight copper cylinder A about 8 in. × 6 in. diameter, completely covered with the material L to be tested.

A 32-C.P. incandescent lamp, without cap, is hung inside, the leads passing through a packed gland which is movable to admit



Arrangement of Apparatus.

the lamp; V is a voltmeter across the lamp terminals, and A an ammeter inserted with a rheostat R in one of the wires from the supply main.

The interior of the cylinder communicates by a tube T of brass and glass tube G and flexible tube F with a cistern of mercury C, and the pressure of the imprisoned air is shown by the mercury column. As pressure is generated the cup C is raised, so that the mercury in G is kept to a fixed point, and the pressure or temperature is read by the height of C on the scale S. The device is simply an air thermometer, and should be fairly reliable for the purpose. The vessel A is the bulb of the thermometer, which does not read by volume but by pressure, the volume not being allowed to vary but being always kept to its initial value by raising C.

The initial temperature of the cylinder is found by a thermometer fixed under the lagging L, and the dryer cup tap D is opened to give one atmosphere pressure when the mercury in G stands at the zero of the scale. The height to which C must be raised to give the proper pressure is calculated. Thus, if a pressure of 146 lb. abs. represents 180° C. with the barometer at 765 mm., and the initial temperature is 10° C., the height of C must be 454 mm., and the flexible pipe F must, therefore, be of considerable length so as to allow of this movement. All being ready, the tap at D is closed, current is turned on, C is steadily raised so as to keep the proper zero reading of mercury in G, and when the desired temperature is approached the flow of current is regulated at R until all keeps steady for 10 to 15 minutes. This is best done in steps, taking readings at each change of 10° C. Readings are best taken on a down grade of temperature. The heat lost through the lagging is calculated from the electricity expended as follows:—

Volts × amps. × 0·24 = Calories per second.
Volts × amps. × 0·057 = B.Th.U. per minute.

The apparatus can be used for any number of tests of different materials and different thicknesses. Any good lagging ⅝ in. thick will permit of tests from 220° C. downwards, or, with thicker coverings, upwards. From 130° C., and below, a 16-C.P. lamp will be better.

A moving-coil ammeter is recommended, range 0 to 2 amperes, readable to 0·01 ampere, with current at 100 volts, or with a range of 0 to 1 ampere for 200-volt current. Moving-coil voltmeters should read to 0·5 volt. For A.C. work, hot-wire instruments are advised. A continuous wire resistance of 0 to 250 ohms will permit of all necessary adjustment.

With this simple apparatus, tests will be made and published under various conditions, and for various thicknesses of numerous insulating materials. The apparatus seems well calculated for the work it is intended to perform.

THE PRACTICAL OPERATION OF MERCURY VAPOUR RECTIFIERS.*

At the present time there are only two forms of the mercury rectifier on the market—that of the Cooper-Hewitt Electric Co. and that of the General Electric Co. In principle both are alike, as they depend on the action of inductive resistances for the main-

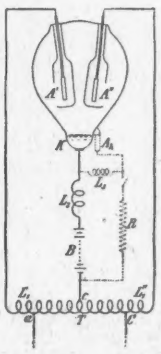


Fig. 1.

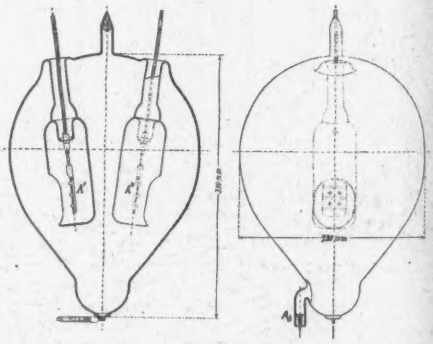


Fig. 2.

tenance of the working arc during the periods when the supply current curve passes through zero. The shape and arrangement of the bulb and the connections are, however, different in the two makes. The Cooper-Hewitt Electric Co. (figs. 1 and 2) uses a pear-shaped bulb with two iron anodes A' A'' and a starting electrode A_3

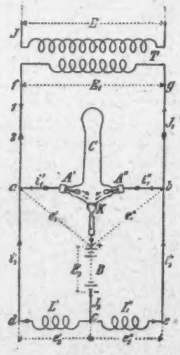


Fig. 3.

of mercury. The current is led in by platinum wires which are enlarged at the point of contact with the glass, so as to reduce the

* Josef Polak. *E.T.Z.*, July 25th, 1907.

risk of breakage through heating. The bulb used by the General Electric Co. (fig. 3) is of a longer form, with a large cooling chamber attached. The two anodes are graphite rods of star section placed in separate chambers, and current is led in by platinum wires melted into the glass over a considerable length. These platinum wires are of small section—the 30-ampere rectifier, for instance, has two 1-mm. diameter wires to each electrode. The leading-in wires for the mercury cathode end in small metal plates, which almost fill up the contracted bulb end and so protect the junctions against shocks from the mercury during transport. Both rectifiers are started by tilting the bulb so as to form a temporary mercury short-circuit. In the Hewitt arrangement the apparatus is mounted on knife-edges and is automatically tilted by an electro-magnet. The General Electric Co. mount the bulb in a brass wire holder fitted with a handle for tilting.

The capacity of a given bulb as regards electrical output is determined by three considerations:—

1. The maximum permissible current with the existing methods of construction is limited. With glass bulbs the limit for each wire melted into the glass is reached at about 40 amps. For larger currents the vessel would have to be of some other material, preferably metal.

2. The heat developed in the arc must be dissipated with a moderate temperature rise, as otherwise it endangers the melting-in points, and also raises the vapour pressure and so increases the voltage drop. Experiment has shown that from ·05 to ·1 watt can be successfully dissipated per sq. cm. of glass surface. Fig. 2 gives the dimensions of a 30-amp. rectifier. For loads over 30 amperes artificial cooling by air blast or by immersion in oil or water becomes necessary.

3. The maximum permissible voltage is determined by the arrangement of the anodes A′ A″. These are situated in highly ionised mercury vapour, and a discharge (of alternating polarity) of a few milliamperes may occur. This discharge tends to warm its cathode, and, especially if the supply voltage is high, may eventually change from a gas discharge into an actual arc, which constitutes a short-circuit and destroys the bulb. To prevent this occurrence the Cooper-Hewitt Co. place the two anodes in separate glass cups with openings on opposite sides (fig. 2), whilst the General Electric Co. make the anode recesses very long and narrow. Fig. 4 shows a General Electric rectifier for 18,000 volts primary and 6,000 volts 4 amperes secondary. Bulbs for as much as 36,000 primary volts have been constructed for laboratory purposes by the General Electric Co.

When a battery is available and the connections in fig. 1 (full lines) are adopted, K is the positive terminal at starting and A_A the negative one. The unidirectional current then goes through A_A and has to be transferred to K. This change is brought about in the Cooper-Hewitt lamp by means of the small reactance L_6. The arc is first formed with A_A as the cathode, and then the two electrodes are temporarily connected, and K becomes the cathode. The double connection and disconnection of the terminals usually occurs automatically with a single tilting, and the whole starting operation is instantaneous. The automatic tilting magnet is conveniently introduced into L_6, and is also arranged to break the auxiliary circuit as soon as starting is accomplished. In some cases the magnet is arranged to introduce a fresh rectifier automatically in case of breakdown, or to vary the number of rectifiers in parallel in accordance with the load variations.

If no battery is available, the starting-up must be effected from the alternating side, and the arrangement adopted by the General Electric Co. for this purpose is shown in fig. 5. The switch S_3 is placed at *b*, and the arc started by slight tilting. The rectifier then works on to R_3, which is dimensioned as a starting resistance. The load is then thrown on to the direct-current circuit by moving S_2 to *a*. S_3 is an automatic maximum cut-out. If only one auxiliary electrode is provided, it is necessary to arrange the change-over from the auxiliary to the main electrode at an instant when the former is the anode. To avoid trouble from this cause the G.E. Co. provide two auxiliary electrodes on their H.T. rectifiers (see fig. 4).

For the purpose of voltage regulation, such as is necessary for battery charging, a variable reactance L_2 is provided on the primary side. Such a reactance also adds to the stability of the apparatus with variable supply voltage.

Some interesting oscillograms, taken at Charlottenburg on a 30-amp., 110/155-volt General Electric rectifier, are shown in figs. 6, 7, 8 and 9. Fig. 6 shows the undisturbed alternating-current supply; fig. 7 shows the voltage and current curves of one arc*

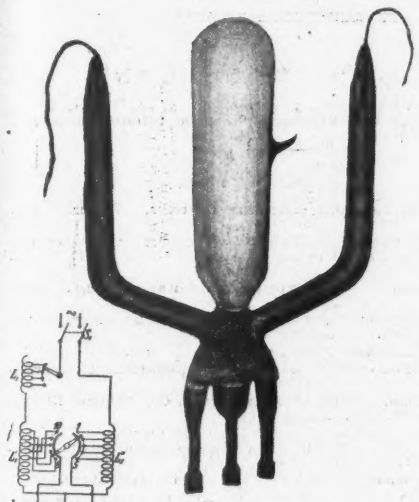


FIG. 4.

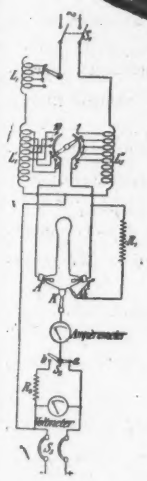


FIG. 5.

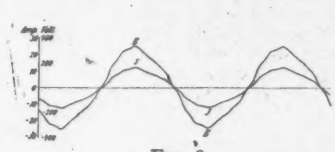


FIG. 6.

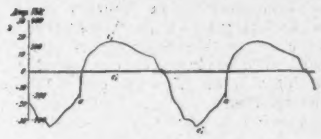


FIG. 7.

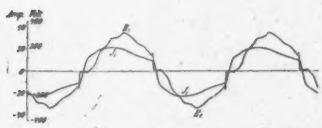


FIG. 8.

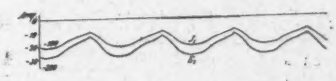


FIG. 9.

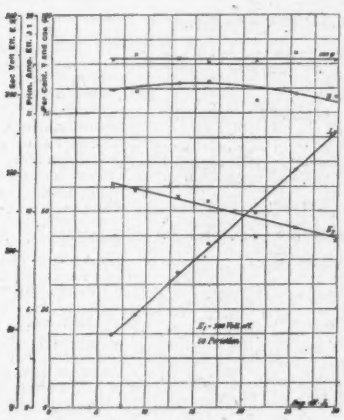


FIG. 10.

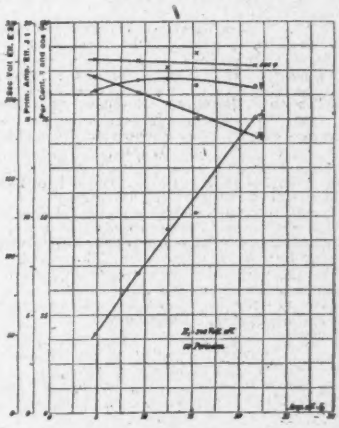


FIG. 11.

fig. 8 shows the distorted primary voltage and current with the rectifier at work; and fig. 9 shows the unidirectional voltage and current curves (working on a non-inductive circuit). The variation

$$\frac{J_2 \text{ maximum} - J_2 \text{ minimum}}{2\ J_2 \text{ average}}$$

is equal to ·36.

The valve action of such a rectifier is found to continue unchanged even up to as much as 25,000 cycles per second.

Figs. 10 and 11 show the characteristic curves of the above rectifier with the minimum (contacts 1 and 6) and the maximum (contacts 5 and 10) resistance in circuit, respectively; E_1 and J_1 are the primary voltage and current, E_2 and J_2 the secondary voltage and current, and η is the efficiency.

It will be seen that with constant supply voltage the secondary voltage curve has a droop similar to that of a shunt dynamo, so that the parallel working of such rectifiers is possible.

During the fortnight that the above tests lasted the rectifier gave no trouble, starting up readily and reaching its steady state after a few minutes. The minimum current at which the rectifier would continue to work was 6·2 amps. with the smallest reactance, and 4·4 amps with the largest reactance.

The losses in such a rectifier consist of iron and copper losses in the reactances, and of ohmic loss in the arc. The latter alone is

* The appearance of the curves is misleading, owing to the small scale; dividing the cycle into four parts, i_1 is zero during the first and third, and positive during the second and fourth, while e_1 is zero during the second and fourth, and negative for the rest of the time.

strictly a rectifier loss, and, since the voltage drop in the arc is practically constant independently of the current, the efficiency of the rectifier itself depends only on the average secondary voltage employed. The ordinary rectifier, up to 400 primary volts, has a drop in the arc of 14 to 20 volts, whilst for the H.T. rectifier the drop is about 25 volts.

In conclusion, the author discusses the possible applications of these rectifiers. The apparatus compares favourably with a transformer as regards absence of moving mechanism, space occupied, and the small amount of attention required. Its efficiency is high, even in the smallest sizes, and is almost independent of the load. When charging cells there is no danger of reversal of current. Amongst the disadvantages is the use of glass for the bulb material, as this limits the current and the life of the rectifier. It is, however, cheap, and improvements in the method of leading-in the current are likely to be introduced in course of time. Another disadvantage is the pulsating nature of the unidirectional current. These pulsations can, however, be damped out as much as is desired by increasing the inductive resistance L_2 (fig. 1). When used for driving direct-current motors, L_2 can be replaced by the internal inductance of the motor; a laminated field magnet will, however, be necessary. The question whether a battery suffers through being charged by a pulsating current remains to be decided by experiment.

The mercury rectifier is not only suitable for transmitting energy at constant voltage, but has also been used in constant-current installations—*e.g.*, the lighting of 25 to 75 magnetite lamps in series, taking 20 to 100 volts each. For this purpose either a single H.T. rectifier or a number of L.T. rectifiers in series may be used. The latter arrangement gives a cheaper apparatus, but the efficiency is lower, owing to the additional 16 to 20 volts lost in each rectifier.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

24,448 A/06. "Improvements in and relating to the control of electric motors." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.) (Date applied for under Rule 5 of the Patents Rules, 1905, November 1st, 1906.) November 25th, 1907.

26,048. "Improvements in commutating devices for electrical machines." E. Windrath. November 25th. (Complete.)

26,049. "Improved method of driving motor vehicles by means of electric transmission of power." Siemens Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, November 27th, 1906, being date of application in Germany.) November 25th. (Complete.)

26,055. "Device for separating iron particles from chaff and the like by means of magnets." J. Hagmuller. November 25th.

26,081. "Electric meter for direct current having a permanent magnet and an armature oscillatory in the field thereof." W. Meyerling. (Date applied for under Patents Act, 1901, November 23rd, 1906, being date of application in Germany.) November 25th. (Complete.)

26,084. "Electric meter for continuous current provided with a permanent magnet and an armature arranged in the field thereof." W. Meyerling. (Date applied for under Patents Act, 1901, November 23rd, 1906, being date of application in Germany.) November 25th. (Complete.)

26,089. "Improved current collector for use in electric traction systems." A. West. November 26th.

26,108. "Improvements in electrical advertising devices." G. H. Clark and W. H. Whittaker. November 26th.

26,118. "Improved electric lamp adaptors." G. Wallace. November 26th.

26,130. "Improvements in electric furnaces." G. Brewer. (E. R. Taylor, United States.) November 26th. (Complete.)

26,134. "Improvements in rotors of alternating current machines." Siemens Bros. Dynamo Works, Ltd., and J. Birrer. November 26th. (Complete.)

26,135. "Improvements in enclosed arc electric lamps." G. W. Farthing and T. K. Steanes. November 26th.

26,143. "Improvements in lifting magnets." A. C. Eastwood. November 26th. (Complete.)

26,144. "Improvements in lifting magnets." A. C. Eastwood. November 26th. (Complete.)

26,147. "Improvements in electrical fuse-boxes." E. A. Whitney. November 26th.

26,179. "Improvements in the manufacture of hollow metal filaments for incandescent electric lamps." F. W. Le Tall. (A. Lederer, Austria.) November 26th.

26,201. "Improvements in heating apparatus." J. A. Moses. November 27th.

26,207. "Improvements in small electro-magnetic machines." F. Burks. November 27th.

26,228. "Improvements in and relating to controlling gear for electric motors." Crompton & Co., Ltd., and C. Crompton. November 27th.

26,229. "Improvements in and relating to starting and regulating switchgear for electric motors." Crompton & Co., Ltd., and C. Crompton. November 27th.

26,251. "Improvements in telephone systems." A. A. Monson. (Date applied for under Patents Act, 1901, November 27th, 1906, being date of application in United States.) November 27th. (Complete.)

26,281. "Improvements in flexible couplings." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) November 28th. (Complete.)

26,294. "Means of supporting filaments in incandescent electric lamps." F. Harrison. November 28th.

26,298. "Apparatus to register telephone calls automatically and simultaneously at the subscriber's instrument and at the exchange and the like." A. Horner. November 28th,

26,313. "Life-guard for electric tramcars, motor-cars, motor-omnibuses and other power-propelled vehicles." P. Bisset. November 28th. (Complete.)

26,330. "Improvements in or relating to electro-pneumatic tools." A. Palmros, G. A. Wagner and J. L. Wagner. November 28th. (Complete.)

26,353. "Improvements in and connected with brush-holders for electrical machines." J. H. Woolliscroft. November 28th.

26,354. "Improvements in electric welding machines." M. B. Ryan. November 28th. (Complete.)

26,371. "Improvements in conductors and cables for telegraphic, telephonic or other electrical transmission." H. Hartnell. November 29th.

26,381. "Improvements in electric accumulator sub-stations." A. M. Taylor. November 29th.

26,404. "Improvements in or relating to speed controlling apparatus for electric motors." Siemens Bros. Dynamo Works, Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) November 29th. (Complete.)

26,417. "Improved method and means for heating by electricity." J. E. Rosenthal. November 29th.

26,418. "Improvements in and relating to the transmission of a series of electric impulses along land lines or cables." A. Orling, T. Inkersole and E. Oldenbourg. November 29th.

26,420. "Method of extinguishing electric arc lamps." Beck Flame Lamp, Ltd. (Deutsche Beck Bogenlampen G.m.b.H., Germany.) November 29th. (Complete.)

26,435. "Improvements in electrical ignition apparatus for internal combustion engines." R. Bosch (trading as the firm of Robert Bosch). (Date applied for under Patents Act, 1901, February 7th, 1907, being date of application in Germany.) November 29th. (Complete.)

26,346. "Improvements in sparking plugs for internal combustion engines." R. Bosch (trading as the firm of Robert Bosch). (Date applied for under Patents Act, 1901, December 7th, 1906, being date of application in Germany.) November 29th. (Complete.)

26,440. "Improvements in electrical fire alarms especially applicable to fire hydrants." S. C. Lambert. November 29th.

26,489. "Conduit-threading device." A. H. de Vos. November 30th. (Complete.)

26,530. "Improved system of radio-telephony." Gesellschaft fur Drahtlose Telegraphie m.b.H. (Date applied for under Patents Act, 1901, December 19th, 1906, being date of application in Germany.) November 30th. (Complete.)

26,531. "Improved receiver arrangement for wireless telegraphy." Gesellschaft fur Drahtlose Telegraphie m.b.H. (Date applied for under Patents Act, 1901, December 3rd, 1906, being date of application in Germany.) November 30th. (Complete.)

PUBLISHED SPECIFICATIONS.

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1906.

Multiple Holder for Electric Incandescent Lamps. G. Wallace. 24,861. October 31st.

Underground Boxes or Chambers Used in Connection with Underground Electrical Cables and for other Purposes. F. J. Chambers. 24,472. November 2nd.

Gravity-Fed Arc Lamps. F. Blanckensee, G. McMullen and F. Mosey. 24,950. November 6th.

Rotors for Dynamo-Electric Machines. British Thomson-Houston Co. and W. F. Dawson. 24,968. November 6th.

Electric Incandescent Lamps. A. Lederer. 24,978. November 6th.

Electrolytic Deposition of Metals. S. O. Cowper-Coles. 24,986. November 6th.

Electric Transformers. British Thomson-Houston Co. (General Electric Co., United States.) 25,204. November 8th.

Electrically-Driven Machines for Vacuum Dust Extracting, said Machines being Applicable for Cleaning Carpets, Hangings, Clothes and the like. G. F. Higgins and Light Electric Motor Co. 26,112. November 19th.

Electrolytic Deposition of Metals. J. Taylor. 26,144. November 19th.

Magneto-Electric Generators for Ignition in Internal Combustion Motors. Albion Motor Car Co. and T. B. Murray. 27,570. December 4th.

Brush Gear of Dynamo-Electric Machines and Motors. W. R. V. Marshall. 27,694. December 5th.

Commutators for Dynamo-Electric Machines. F. H. Loring. 29,692. December 31st.

Electroliers. F. C. Dafforn. 29,757. December 31st.

Telegraph and like Posts. F. L. Muirhead. 24,966. November 6th.

Method and Means for Circulating Air Round Electric Motors. T. Johnson. 25,218. November 8th.

Track Brakes for Electric Tramcars and the like. Mountain & Gibson, Ltd., and A. F. H. Head. 25,557. November 13th.

Telephone Exchange Systems. E. E. Clement. 28,091. December 10th. (Rights under Patents, &c., Act, 1901, not granted.)

Electric Lighting of Trains. W. R. Preston, C. Roe and C. H. Roe. 29,423. December 24th.

Measuring Instruments for Electric Storage Batteries. H. Brazil and F. Lydall. 29,748. December 31st.

1907.

Space Telegraphy. S. Cabot. 6,095. March 13th. (Date applied for under International Convention, April 4th, 1906.)

Insulators for Electric Conductors. H. H. Lake. (W. G. Clark, United States.) 7,651. March 30th.

Oscillatory Circuits of Radio-Telegraph Systems. Amalgamated Radio-Telegraph Co. (H. Rosenthal, Germany.) 9,028. April 18th.

Systems of Electrical Distribution by means of Vapour-Electric Apparatus. P. H. Thomas. 10,126. May 1st. (Date applied for under International Convention, May 5th, 1906.)

Single Line Intercommunication Telephone Systems. I. B. Birnbaum and H. A. White. 10,431. May 4th.

Trolley Wheels or Collectors for Electricity. A. A. Schneider. 11,285. May 14th.

Indicating Apparatus for Electric Meters. A. Baumann. 11,983. May 15th. (Date applied for under International Convention, May 16th, 1906.)

Dynamo-Electric Machines and Motors. Siemens Bros. Dynamo Works and M. Kloss. 12,050. May 24th.

Method of and Apparatus for Fault Location on Electrical Conductors. H. G. C. Fairweather. (H. M. Friendly, United States.) 13,563. June 12th.

Insulation of Electric Conductors and Compounds Therefor. W. A. Phillips and F. Hutchins. 14,949. June 17th.

Electro-Magnetic Appliances for Playing Pianos and other Musical Instruments. F. Schubee. 14,637. June 25th.

Arc Lamps. J. C. Chalmers and W. A. Robertson. 16,027. July 12th.

Holders or Fittings for Electric Incandescent Lamps. A. Loebl and British Ever-Ready Electrical Co. 17,006. July 25th.

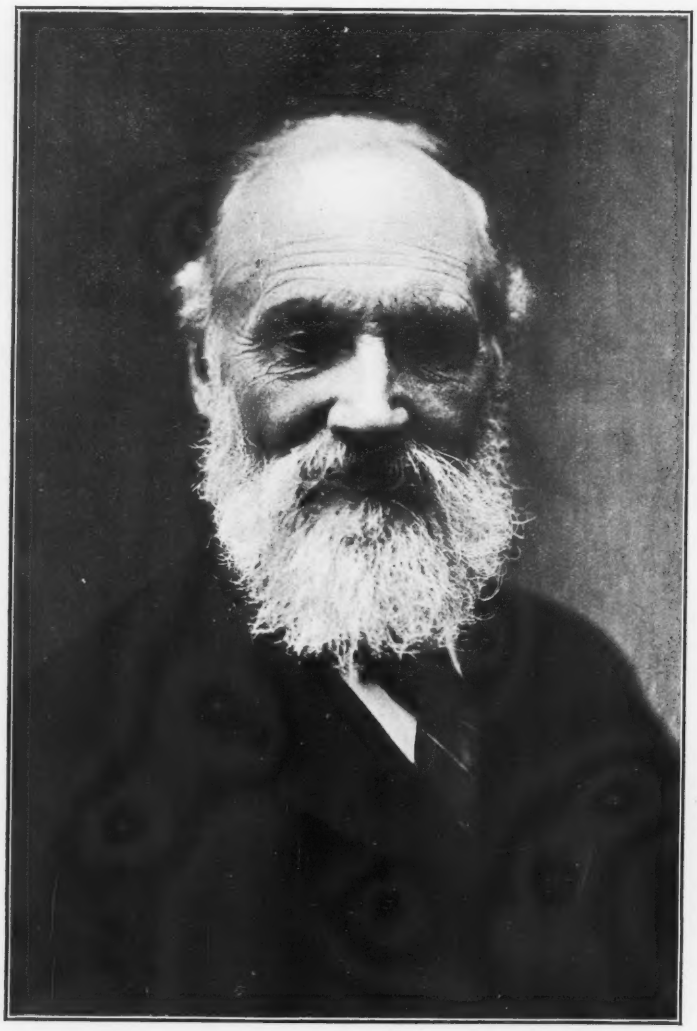
Electric Candle Lamps. A. Bonnella and G. J. Bonnella. 17,309. July 29th.

Electric Furnaces. H. Pauling. 18,901. August 22nd.

Electric Accumulator and other Cells. H. Leitner. 517. January 8th.

Electrical Fuse-Boxes. W. T. Henley's Telegraph Works Co. and W. H. Nichols. 2,121. January 28th.

Trolley Wheels as Used in the Trolley Heads of Electric Tramcars Worked on the Overhead Trolley System. A. T. Birkby and F. E. Birkby. 2,850. February 16th.



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JUNE 24, 1824—DECEMBER 17, 1907.